



FIG. 4.
MBEMKURU
RIVER IN
DRY SEASON.



FIG. 5.—SITE M 1.



FIG. 6.—SITE M 2.

other hand, were highly crystallized, and yet others had lime deposits on the upper surfaces, while some were very decomposed. Other features were, that some of the bones seemed to have been fractured in life, and to have healed with a bad set, and others had apparently been broken at or immediately after death and while the muscles were still operative. This site gave one the impression of having been a pool in the bed of a river which flowed only during part of the year. We may figure to ourselves a region suffering a process of desiccation such as is going on in lands bordering on the southern Sahara at the present day, and coming on again in the Tendaguru region also though less advanced. All living things flocked to the remaining pools of water for vegetation to eat and such water to drink as was left in the bed of a dried-up river; and here they perished when the water dried up. A subsequent good rainy season could not help them as all was over. Sand swept over and covered their remains, and the brief annual flow of the river in subsequent years buried them completely. At M 2 site the bones were principally embedded in a matrix of soft sandstone or even loose clean white sand; at M 1, on the other hand, the deposit was a grey clay.

Site M 3 (745 ft.), at a long distance from M 2, produced a femur, in poor condition, 7 ft. long, with a small humerus close to it and, besides other very bad bones which were not removed, at a little distance lay a very big vertebra in good condition; here the deposit was sand.

Close to M 3 was M 4 (765 ft.), where a small femur, 12 inches long, and a corresponding humerus were found, together with damaged and scattered bones of larger animals which have not been removed.

Site M 5 (Fig. 7) (635 ft.), on the north side of Tendaguru hill, was a hillside working. It promised well at first with the discovery of a short line of small vertebræ, but all subsequent bones were mere fragments, and, as the deposit was one of much-contorted clays, it was abandoned.

Site M 6 (700 ft.), on the west side of Tendaguru hill, only produced many scattered and unassociated bones in sand and clay, and it was here that numerous belemnites were found, indicating that to this side of the hill a salt-water estuary had reached.

M 7 (Fig. 8) (740 ft.) is a cutting into Tendaguru hill itself, and is one of promise. The products were interesting, and work is still going on there. I had from the first been desirous of digging into Tendaguru hill, standing as it does on the top



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Natural History Magazine

No. 2

APRIL, 1927

PUMA: A NEW EXHIBIT.

By J. G. DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

A SOUTH AMERICAN Puma (*Felis concolor pearsoni*) has recently been presented to the Museum by the Rowland Ward Trustees. Formerly the species was represented in the Exhibition Series by only a North American specimen. The animal was mounted in the Rowland Ward studios and is now exhibited in the Leopard case in the Lower Mammal Gallery.



Photograph by

PUMA.

Rowland Ward, Ltd.

Pumas vary considerably in colour, some of the races exhibiting two distinct types of coloration, a red and a grey phase; the present specimen represents the red type. Black, or melanic, Pumas are sometimes met with, although not so frequently as the black variety of Leopard.

Some authors consider the Puma to be generically distinct from the other large cats, such as the Leopard and Jaguar. In North America it is frequently spoken of as a "lion," but there is no close relationship between the Lion proper, found only in the Old World, and the Puma, which is restricted to the New World.

BRITISH MUSEUM EAST AFRICA EXPEDITION.

PROGRESS IN THE YEAR 1926.

By F. W. H. MIGEOD, Leader, September 1925–December 1926.

PRACTICALLY the only object of the expedition was the excavation of the dinosaur remains at Tendaguru in Tanganyika Territory. Digging had been done here by the Germans for about six years before the outbreak of war, and many fine specimens had been obtained. Then for ten years the ground

lay derelict, until early in 1924 the British Museum sent out an expedition in charge of Mr. W. E. Cutler to resume work there. Mr. Cutler unfortunately died on the 30th August, 1925, from the effects of malaria, and work was almost entirely suspended until I arrived at Tendaguru in the middle of November of the same year to take his place.

During the twelve months under review an investigation was made of thirteen different sites round Tendaguru hill, none being more than a mile distant in a straight line, though of course usually much further by the bush paths; in addition some prospecting was done further afield,



F. W. H. MIGEOD.

Leader, British Museum East Africa Expedition,
September 1925–December 1926.

but in view of the possibility of the work of the expedition in this locality continuing for more than one year, I decided to make an intensive study of the immediate neighbourhood first. All these thirteen diggings except one proved productive to at least some extent, and the single one which yielded no remains was not without value, since it afforded an idea of the limit

of the productive strata. Of these diggings the larger number yielded bones associated together, those with scattered and unrelated bones being comparatively few. Altogether the excavated material represented about thirty dinosaurs of several different species; in addition a few fossil molluscs were met with.

It was only necessary to walk about the country in the neighbourhood of Tendaguru after the grass had been burnt in the dry season to see clearly how vast is this graveyard of dinosaurs. Denudation in the course of ages has removed the many strata of rock which had been piled up on their remains, and once again these bones lie close to the surface. Most of the damage to them has been done in quite recent years through the penetration of the roots of vegetation. At the present day the bone-bearing strata lie at an average level of 650-750 ft. above the sea. Fragments of bone on the surface commonly, though by no means always, give an indication of the position of other bones. The stratum, however, is not always an indication that bones may be found there, for the dinosaurs which I collected lay in several different kinds of ground—in clays of more than one kind, some stratified and some much contorted, in loose sand and in hard sand-rock.

Tendaguru hill itself, rising like an island with steep scarped sides above the surrounding country, stands on the edge of a deeply furrowed plateau at the point where it dominates the valley of the Mbemkuru river five miles distant in a westerly direction. To the north, east and south some few miles distant are still higher plateaus. Tendaguru hill, therefore, represents a partially worn-down portion of these hills—a small surviving isolated fragment. On its top, a height of about 850 ft. above sea-level, there is a thin layer of smooth river gravel. This small wooded hill stands conspicuously alone in a large area of level wooded country. The ground all around is much broken with deep water-courses, which are not seen until actually encountered and, except during rain, are always dry. There are no villages near, only scattered farms, and the vegetation is the savannah type of forest.

To the west and north flows the Mbemkuru (Fig. 4), a small river which is dry most of the year, and to which there is a fall of about 500 ft. from the average level of the bone-bearing strata. The presumption is that this depth has been scoured out and the present river is but the small remnant of a mightier one which originally flowed at a much higher level and met the sea to the south of Tendaguru instead of to the



FIG. 1.—LINDI,
THE OLD FORT.



FIG. 2.—LINDI,
THE HARBOUR.



FIG. 3.
BRITISH MUSEUM
VILLAGE, FROM
TENDAGURU
HILL.

north as at present. The numerous ridges that run down in its direction from Tendaguru hill are bone-bearing on the top only. If any bones are found in the intervening ravines they have been weathered out above and have fallen down. In only one of these ravines did I find fossil shells; they were at the 630 ft. level.

When I arrived at Tendaguru there was nothing to indicate which was the best place to continue my predecessor's work, and no information to be gleaned. I therefore began on a site which I called M 1 (Fig. 5), where Mr. Cutler had begun some work and where there were a great number of German ditches. This site (715 ft. level) yielded first a small dinosaur, which has been unpacked in the Museum, and near it one of very great size. The relative bulk of the skeletons may be gauged by the fact that the former packed into nine light head-loads for transport to Lindi, and the latter required eighty carriers in all to take it down. Some idea of the size of the latter when living may be formed from the fact that the scapulæ measure 48 inches long and 28 inches across at the widest part. The larger part of the body had lain on a bank, but an ancient stream, now no more, had disturbed the remains on the one side, some of the bones showing plainly the action of the water. Mixed with the bones on this side were numerous pebbles, two being found jammed tightly under a rib, causing it to bend out of its true curve. The upper limb bones, pelvis, and dorsal vertebræ had apparently not been touched by the stream, though the vertebral processes had all been much broken up. These vertebræ dwindle in size from over a foot to no more than an inch in diameter.

The next site (645 ft. level) M 2 (Fig. 6), at which I worked at the same time as the previous one—in fact usually about three diggings were kept going together—lay about a mile off. Here a space about 88 ft. by 64 ft. was dug out, and the bones lay so thickly that it was difficult to walk among them. None of the bones at this site was of outstanding size, and, though they bore evidence of disturbance, many lay in proper association with one another. The biggest were a femur of 55 inches and a humerus of 40 inches in length, and several others were not much smaller. At the other end of the scale was a pair of femora 14 inches in length, which were those of a young one; and there were fragments of others equally small. An interesting feature was the varying states of preservation of the bones, even in those of the same skeleton. Some were in excellent condition with the breaks sharp and clean; others, on the



FIG. 7.—SITE M 5.



FIG. 8. —SITE M 7.

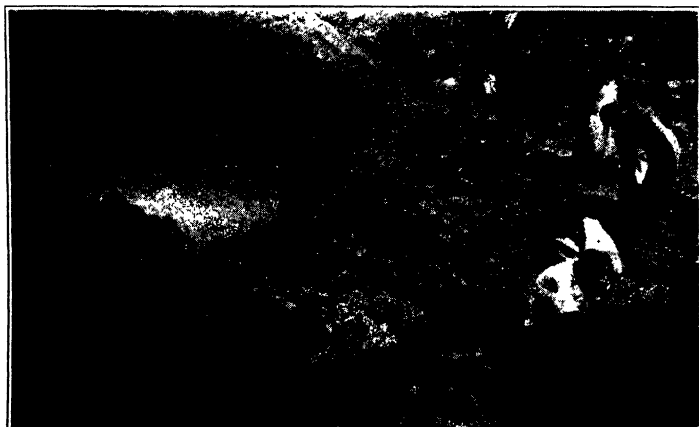


FIG. 9.—SITE M 8.

of the deposits, and for the additional reason that if cut into deeply the bones found might have escaped the destructive action of present-day root penetration. Two bone levels were exposed at a vertical difference of about three feet. The upper level yielded the bones of one or more very large dinosaurs : a femur measuring 67 inches in such a good state of preservation that it was plastered whole, when it weighed nearly 4 cwt. ; a humerus about 5 ft. long with the ends incomplete was another find on this level, besides ribs, vertebræ, etc. The stratum was greenish-grey clay. This clay rested on a bed of sand, and here at the meeting of the two strata, or slightly embedded in the soft sandstone stratum below, other bones of an apparently different species of dinosaur were found.

M 8 (Fig. 9) (755 ft.) site yielded a fairly complete skeleton which may have run to nearly 40 ft. in length but of slender build. The femur was 51 inches, scapula $44\frac{1}{2}$ inches, and the humerus 33 inches in length, and most of the bones lay in their proper relative positions. The tail, which was intact, was about 15 ft. in length ; for about 11 ft. it lay straight out, but between the 11 ft. point and the body it had been pressed down about two feet into the ground. It was not completely severed, but the vertebræ nearest the pelvis were hanging vertically. There were two or three at the bottom, and one or two nearly vertical again connecting with the unbroken part of the tail. It was as if at death or shortly after some other huge dinosaur had set its foot on the root of the tail in passing and pressed that part of it down into the mud. The fore-part of the body was on a slightly lower level than the hind-part, and the head and neck, which were displaced, were in a position suggesting that it had died in drinking or trying to drink water. The displacement of the bones would be readily accounted for had they lain in running water while the main body of the skeleton lay on dry land or at least in mud. In the circumstances several masses of mixed bones had to be plastered, my hope being that the skull would be found therein, as a small portion seemed to indicate. This skeleton lay as a whole in a reddish-brown clay rather darker than laterite, and enclosing the bones was a green matrix, which did not exist apart from the bones.

Of the remaining five sites, four of them near one another and north of Tendaguru hill, M 9 (710 ft.) and M 10 (690 ft.) yielded nothing of particular interest, and at M 11 (710 ft.) were found only a few decomposed fragments of bones and a claw.

M 12 yielded part of a small animal, and M 13, the last excavation made before I left, which lay some distance to the south, yielded a single femur in very good condition, and nothing else.

The bones are not all in perfect condition, and, whilst for purposes of study it was necessary when dealing with associated bones to collect every fragment, the number of skeletons or parts of skeletons suitable for show purposes was small. On the whole, the majority of the groups of bones excavated were associated with one another and were not drift bones.

It was not possible to do much in other branches of natural history, but a collection was made of the plants in the immediate vicinity of Tendaguru, and a few fishes from the Mbemkuru river were also preserved, and at Lindi some fossils and sea-shells were collected and an initial exploration was made of a large series of caves.

A few general notes on the field work may be of interest. It has not hitherto been the usual practice in excavation work to continue throughout the year, but going out, as I did, shortly before the rainy season, I decided not to break off the work, and the results were quite satisfactory. The rainfall was not excessive, and even an occasional flooding of a working did not delay progress for more than half a day, as the parts that could not be drained were soon baled out. For this reason I established continuous work, and so doubled the possible output for the year, and, further, retained the trained diggers.

There is as yet no made road suitable for loaded motor-lorries from Tendaguru to its port Lindi, though two light cars did on one occasion in the middle of the dry season succeed in getting through. Hence the bones have to be carried down by the labourers of the expedition, who take it in turns to go, a much safer method than motor transport on a bad road. As far as possible the bones were packed in single head-loads of about half a cwt. each, and all empty kerosene or petrol cases were bought up in Lindi for the purpose. Since these boxes were not strong enough to stand transport by steamer, big packing cases were made at Lindi, and into each of them, made exactly to fit, three kerosene boxes were dropped. There was, therefore, no repacking of the smaller bones necessary. The larger bones travelled down made up into bundles with grass and bamboos and tied on to long poles; and on arrival packing cases were made as necessary for them. About every three

months, depending on the very irregular steamship service to Lindi, a consignment went home. By sending the bones down in the smallest possible packages transport was greatly facilitated.

I was generally able to get all the labour I needed, and found a maximum of forty men sufficient for all purposes, including transport, these being distributed in parties of ten men or less in one place. Their output was about the maximum I was able permanently to deal with. Having been accustomed to the more intelligent natives of West Africa, I found the East African natives somewhat trying. The enormous difference in brain-power is, of course, not apparent to Europeans who only know East Africa. The labourers were drawn from several tribes, principally from the WaMuera, WaYao, and WaNgoni. A few of the original men with whom I started settled down to the work well, and were still employed at the end of twelve months. These had become useful and earned more than the standard wage of 18s. (including ration money) a month.

Food was a difficulty, and in the dry season the water supply was a cause of anxiety, but it did not entirely give out. The country could produce plenty of food if only it were grown, but the local population is inert. Everything, therefore, had to be bought from the Indian traders at Lindi and carried up to Tendaguru. Even fowls, eggs, etc., could seldom be obtained, and only from considerable distances. Some chiefs had conceived the idea that it would please the Administration if they were unhelpful to non-official Europeans and refused to sell them food; and I may add that none of those in the neighbourhood of Tendaguru was ever helpful in the least degree.

The net result of the first twelve months' work of the expedition since its resumption is that 431 boxes or packages of bones were sent down to the coast, requiring 530 carriers to take them.

The European staff consisted of Major T. Deacon and myself. Major Deacon followed me out and was stationed most of the year at Lindi to supervise shipments, etc. On my departure back to England, I left the work at Tendaguru in the hands of Mr. G. W. Parlett and Mr. W. Kershaw, who joined the expedition locally, and left instructions with them as to the continuance of the digging until the arrival of my successor.

INTERESTING BRITISH BUTTERFLIES FROM THE INGALL COLLECTION.

By N. D. RILEY, Assistant Keeper, Department of Entomology.

THOMAS INGALL, formerly a clerk in the Bank of England, who died nearly seventy years ago, was noted in his day for his interest in Entomology, and more particularly for the number of rarities "contained in his Cabinet," to borrow a phrase from the period during which he lived, although from his will at Somerset House it appears that he was by no means a wealthy man. Curiously enough his will makes no mention of his collections, yet on the 27th May, 1863, Messrs. Sleigh, Sotheby and John Wilkinson sold by auction "the well-known and distinguished collection of British Insects formed by the late Mr. Ingall . . . contained in eight solid mahogany cabinets and thirty-eight store-boxes." The history of the collection in the following years has been lost, but it appears that about 1884 it was presented by a Dr. Schuster to St. Bartholomew's Hospital, where it remained in the museum until quite recently.

Included in the collection were numerous examples of species long since extinct in these islands, or already nearing extinction. The British Large Copper Butterfly (*Heodes dispar*), for example, was represented by twelve fine males and nine females. One of the former bears the date 1841, and from published records is clearly a specimen bred by Ingall from a caterpillar sent to him in June, 1841, from Whittlesea Mere, Cambridgeshire, by H. Doubleday. The last recorded British capture of this species was in 1847 or 1848. Quite recently the species has been rediscovered in a very restricted area in Holland, in a form very closely resembling our extinct British race—but in the writer's opinion distinguishable from it—and differing considerably from the better known continental race *rutilus*. Another near ally used to occur in the marshes near St. Quentin in the Somme Valley, Northern France, but has not been met with since the War. It is feared that, like our British race, it too is now extinct. Even fewer specimens of the St. Quentin than of our British race are known to exist in collections; it is believed that no collection contains more than fifteen or twenty of the former, whereas, with the addition of the twenty-one specimens mentioned above, there are now no less than 120 of the latter in the National Collection.

Other interesting species represented in the Ingall Collection were the Mazarine Blue (*Nomiades semiargus*), a butterfly not

met with alive in this country since about 1877, when a few were captured in Glamorganshire; the Black-veined White (*Aporia crataegi*), formerly almost a pest in certain parts of the south of England, but now, if rumour is correct, already vanished from its last remaining Kentish stronghold; and the Large Blue (*Lycæna arion*), a species formerly widespread in the south-west of England, but now maintaining itself precariously in two localities only, and threatened severely in one of them unless the recently formed Committee for the Protection of British Butterflies is successful in creating, as it hopes to do, a local reserve for it.

Specimens of all these species, and of many others, were very generously presented to the Museum by the Governors of St. Bartholomew's Hospital before the rest of the collection, for the second time in its history, passed under the auctioneer's hammer, an event which occurred at Stevens's Rooms on the 23rd November, 1926, when the Museum was fortunate in being able to secure from it the type specimens of twelve species described by Haworth in *Lepidoptera Britannica* (1803-28), some of which were formerly in the Hatchett Collection, which had been bought by Thomas Ingall.

WOOD-WASPS.

By J. WATERSTON, D.Sc., Assistant Keeper, Department of Entomology.

THE "Wood-wasps" (Siricidæ) are a small, compact, and specialized family of the Order Hymenoptera (Bees, Ants, Wasps, etc.), and belong to a division of which the Saw-Flies are the most familiar examples. Though their general shape is elongate and cylindrical, they are stoutly built insects, and the body ends in a characteristic spike, or tail, rising from a triangular base—whence the popular name "Horn-tails." Additional distinguishing features are to be found in the peculiar channelling of the lower part of the face to accommodate the antennæ, in the relatively enormous jaws, and in the parallel reduction in some of the other mouth parts. The legs are strong and in places densely beset with short spines, while the under surface of the thighs bears small teeth like those of a file. All the features just referred to are evidently connected with the fact that the adult Wood-wasp develops from a tree-boring grub, and may have to tunnel its way for a considerable distance through solid wood before reaching the air. In this journey the

jaws clear the way and the spike presumably pushes the creature forward. It is perhaps necessary to add that, notwithstanding their somewhat formidable appearance, these insects, which as already indicated really are not wasps at all, are perfectly harmless to human beings and quite unable to sting.

By means of a stout ovipositor, the female Wood-wasp lays her eggs in the wood of various coniferous trees. Though dry seasoned wood is never selected for this purpose, recently felled trunks are attacked; most observers also are agreed that the

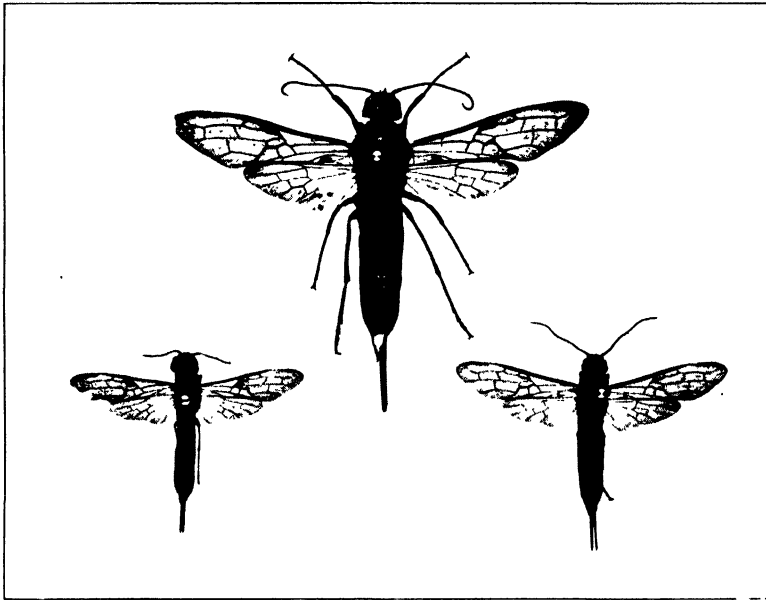


FIG. 1.—THREE FEMALE EXAMPLES OF *Sirex cyaneus*.

Showing the range in size exhibited in this species (all three figures life size).
The smaller specimens emerged from the wooden core in Fig. 2.

living trees to which Wood-wasps entrust their offspring have previously been in bad health. Since the trees infested by these insects are of high commercial value, and the life of the grubs may extend over many months, considerable damage may result from Wood-wasp attack, while the insects themselves may be carried long distances during the course of their development. Even the Atlantic may thus be bridged, while the shorter journey from the Baltic or other north continental ports presents no obstacles at all to these insects.

It is thus difficult to say how many indigenous Wood-wasps we have in Britain. Four species, however, seem now to be

definitely established with us, viz. *Sirex gigas*, *S. noctilio*, *S. juvencus*, and *S. cyaneus*. The first-named, the Common Wood-wasp, is a handsome yellow and black insect. In the others, which are easily separated by colour-markings, details of the wing-nervures, and certain peculiarities of the terminal spike and ovipositor, the prevalent tint of the body is steel-blue.

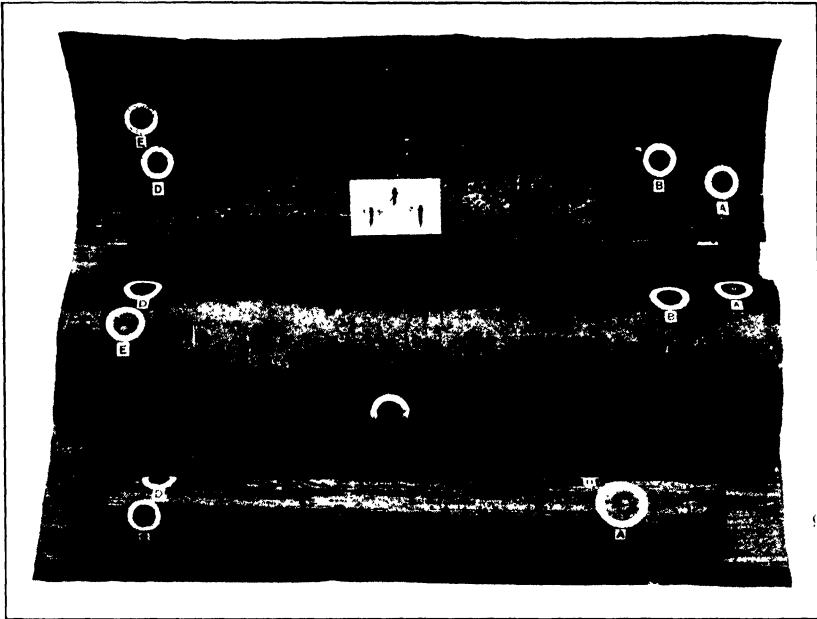


FIG 2.—SHEET LEAD DAMAGED BY WOOD-WASPS.

The wooden core on which the lead was wrapped is shown in the foreground with two consecutive turns of the sheet lead behind. Each turn has been considerably flattened out to show the holes gnawed by the wasps, the inner one (*i.e.* nearer the core) exhibiting the convex and the outer the concave surface. All the rings on the lead surround complete apertures except at E of the outer turn, where the wasp died after getting half-way through. The actual insect is seen at E on the wood: when found, it was partly in the wood and partly in the lead. The holes are beautifully smooth and nearly circular in section.

The damage shown in the accompanying figure is the work of *S. cyaneus*, whose original home is in North America.

During the months of July and August large numbers of Wood-wasps are annually received by the Museum for identification and comment. As can readily be understood, these come from a variety of apparently unrelated situations, *e.g.* from ships, docks, or wood-yards; from crates or packing cases; from the interior of houses or workshops; and even from crowded city streets. Very interesting have been some captures of these

insects emerging from the panelling of post-war bungalows, in whose construction unseasoned wood had evidently been used. Though the chief loss to the forester or wood merchant is caused by the tunnelling of the Wood-wasp grub, popular attention is more naturally drawn to the damage caused by the emerging insects. Occasionally the perfect wasp makes its appearance in a dramatic manner, displaying almost incredible strength and perseverance in escaping from the larval burrow. As a case in point, mention may be made of the following instance, in which the damage done is illustrated by an exhibit recently acquired by the Museum (Fig. 2).

A piece of pine wood, presumably grown in France, was used as a core on which sheet lead was rolled. The wood had previously been infested by larvæ of a Wood-wasp, which completed their development about the time of the reception of the lead by a firm in the City of London, to which it was consigned by manufacturers in Belgium. On emerging from the pupal state the wasps at once took the shortest way out, and, instead of being deflected by their lead covering and boring a tunnel parallel to the long axis of the wood, gnawed a passage through successive layers of lead in their bid for freedom. Some succeeded in getting completely through; others died at various stages of the journey, which, at the shortest, involved boring through one and a half inches of solid metal. The figure shows a portion of one of the three rolls thus damaged. The sheets consist of what is termed "5 lb. lead," *i.e.* 5 lb. to the square foot, and are about one-tenth of an inch thick. Sheet lead is bought in strips some seven feet wide and thirty feet long, and the wood core is about two and a half inches in diameter. There are thus about fifteen thicknesses of lead in a roll.

A NEW EXHIBIT OF LANCELETS, SEA-SQUIRTS AND SALPS, ACORN-WORMS, ETC.

By R. KIRKPATRICK, lately Assistant Keeper, Department of Zoology.

ADVANCING knowledge of the life history and structure of animals has often had the effect of revealing deep-seated differences in organisms that had been supposed to be nearly related, and, conversely, fundamental resemblances in those that had been placed far apart. In no animals is the truth of this statement better shown than in those brought together in Cases A

and B at the south entrance of the Fish Gallery. They present the most varied appearance, inert sacks, tadpole-like creatures, worms, seaweeds, fishes, etc. Not long ago they were variously regarded as molluscs, worms, Polyzoa, fishes, etc., but now not only the fish-like Lancelet, but all the others here exhibited are considered to belong to the great group of Chordata, which includes also the Vertebrates or backboneed animals. The discovery of what appear to be the real affinities of these organisms constitutes an interesting episode in the history of zoology. The fundamental characteristic of the Chordata is the presence, at some time in the life history, of an elastic skeletal rod—the notochord (back-rod); in nearly all the Vertebrates this is replaced by the backbone. Further, there is a tubular central nervous system lying above, *i.e.* dorsal to, the notochord, and lastly the throat communicates with the outside through gill-slits.

The Sea-Squirts were long classed with the Molluscs. In an adult Ascidian there is no trace of a notochord or of a tubular dorsal nervous system. In 1838 Sir J. Graham Dalyell discovered the free-swimming larvæ which he called spinulæ (pin-like). He saw them settle down head-first and develop into the sack-like Sea-Squirts; but it was not till 1866 that Kowalevsky found that the little tadpole-like larvæ had a notochord and dorsal nerve-tube, resembling in this respect the tadpoles of frogs. When the Ascidian tadpole settles down after a short free life it loses its tail and notochord and the nerve-tube is reduced to a small lump. In consequence of Kowalevsky's discovery it became obvious that Sea-Squirts were related to the Vertebrates. The fixed, sack-like Ascidian furnishes a notable example of degeneration.

Again, the worm-like *Balanoglossus* was long regarded as a worm, but it has a peculiar skeletal structure representing a notochord, also a partly hollow dorsal nerve-tube and gill-slits. It is easy to see that the Lancelet is a chordate animal, for it has a well-marked notochord along its whole length, with a dorsal nerve-tube above it but not quite so long, and also gill-slits. The animal, though fish-like in shape, is not a fish, for it has no proper brain or skull, and lacks other features proper to fish.

To return to the two Cases: 15 of the 20 panels are devoted to the Tunicates (Sea-Squirts, Salps, etc.). There are dissections, models and numerous diagrams, for the explanation of which a uniform scheme of colouring and lettering has been adopted. Panels 16–19 show the Hemichordata, viz. *Balano-*

glossus, the seaweed-like *Cephalodiscus*, and the minute encrusting *Rhabdopleura*; in the two latter it is the zooids, living fixed or free in the common "house" they have secreted, that show more or less vaguely some or all of the chordate characters. Lastly, in panel 20 the Lancelet is shown along with pictures of it swimming in the sea and burrowing in the sand, also diagrams and a model. In a small neighbouring case there are further examples, along with models and figures of larval stages and of the various species of Lancelet.

A guide to the simpler Chordata, known as Protochordata, is being prepared.

LUMINOUS SQUIDS AND CUTTLEFISH.

By G. C. ROBSON, M.A., Assistant Keeper, Department of Zoology.

THE Squid or "Calamary" (*Loligo*) is a member of the class of molluscs known as the Cephalopoda, in which the Octopus and Cuttlefish are also placed. Quite recently a number of these strange torpedo-shaped animals were sent for identification to the Natural History Museum by Dr. R. Dollfus of the Muséum d'Histoire Naturelle, Paris. Some of them had been obtained off the coast of Indo-China, and M. Armand Krempf, who captured them, noticed that, when kept alive in a laboratory or seen in a rock pool, they emitted a luminous glow, which proceeded from two curious organs situated within the mantle-cavity, the pouch-like hollow of the body in which the gills are situated.

It is well known that many marine animals are equipped with organs by which a phosphorescent substance is produced and displayed in various parts of their bodies. The most striking examples of such "light-organs" are found in animals that live more or less permanently in the great depths of the sea. Such creatures are often found far below the level to which sunlight can penetrate and spend part or all of their lives in total darkness. The light-organs borne by those animals may be of service in enabling them to seek out their food or to find partners during the mating-season. The members of one large group of cephalopods, many of which descend to very great depths, are distinguished by the profusion and variety of their light-organs.

Light-organs are not, however, found exclusively in animals

inhabiting the deep sea; and the Squids obtained by M. Krempf undoubtedly live in shallow water. The true Squids (*Loligo*) and the Cuttlefish (*Sepia*) do not as a rule possess these structures. Living for the most part in shallow water sufficiently well illuminated by sunlight, they do not require the special source of light which is found in their deep-water relatives.

In 1906, however, Dr. W. T. Meyer, when observing these animals at the Zoological Station at Naples, discovered that *Sepioloa rondeletii* (Fig. 1), a little Cuttlefish from shallow water found commonly in the Mediterranean, and *Heteroteuthis dispar*, a rarer deep-sea Cuttlefish, possessed light-organs of a different kind from those found in the Squids of deep water. He observed that *Heteroteuthis* emitted light, not from the surface of its body where luminous organs are usually situated, but from the interior of its mantle-cavity. On the inner wall of this cavity is to be found a gland from which a dark fluid (the "ink") is poured forth, to serve as a means of concealment when the animal is attacked by an enemy. Dr. Meyer found in these Cuttlefish two light-organs situated on the surface of the ink-sac and projecting into its cavity.

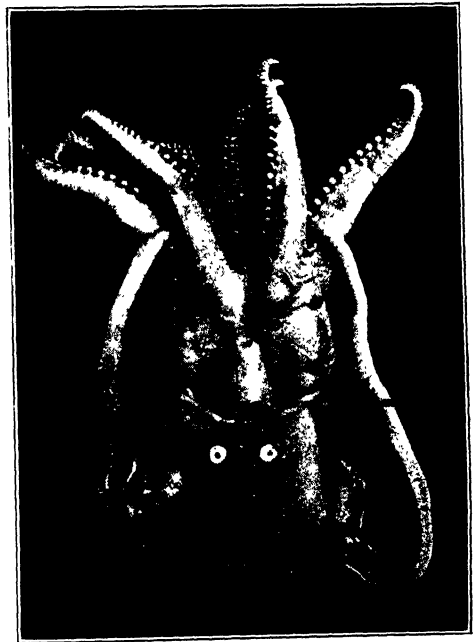


FIG. 1.—*Sepioloa rondeletii*.

m.a. mantle aperture. The white circles indicate the position of the light-organs inside the mantle-cavity.

Unlike the luminous organs found in most cephalopods, those of *Sepioloa rondeletii* and *Heteroteuthis dispar* do not seem to be used only for projecting light. The secretory portion is penetrated by a system of canals, which evidently collect the luminous substance (recently shown by Dr. U. Pierantoni to be of bacterial origin) and pour it out from an aperture situated at the base of the organ. Dr. Meyer witnessed an emission of the phosphorescent substance in *Heteroteuthis*, which he described as coming out of the funnel in a glittering plume like a firework. Although part of the light-

organ projects into the cavity of the ink-sac, it is not yet clear whether the production of the phosphorescent substance has anything to do with that of the ink. The luminous organs in the *Loligo* obtained by M. Krempf in Indo-China have the same general structure as those found in *Sepiolo* and differ only in certain unessential details (Fig. 2).

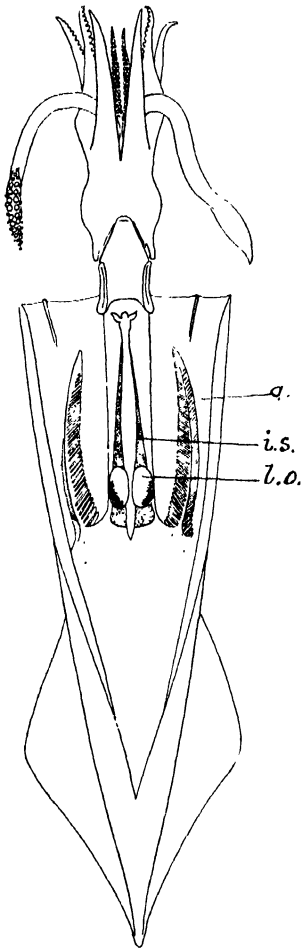


FIG. 2.—*Loligo* sp.

The mantle-cavity has been opened longitudinally: g. gill, i.s. ink-sac., l.o. light-organ.

We may ask what is the reason for the curious position of these organs and why they emit a luminous secretion. Some of the deep-sea Squids have light-organs within the mantle-cavity close to the gills and rectum. But in any case the position of such organs inside the mantle-cavity is quite inexplicable at present. The use of the phosphorescent secretion in *Sepiolo* and the new species of *Loligo* is equally mysterious. It is probably not required as an illuminant. It may, however, be a "means of attraction" used in the mating season. It occurs in males and females alike; but lures of this kind, though often restricted to one sex, are sometimes found in both. In the common Glow-worm, for example, both the male and the female have "luminous organs," though in the female they are better developed than in the male.

If the secretion of these organs is in any way a means of sexual attraction, we cannot as yet decide why they have been developed in so few representatives of this group of animals. It is possible, of course, that they have been overlooked by naturalists who have studied the Cephalopoda, and it is quite likely that, when the structure of the Cuttlefish and true Squids is more systematically studied, further examples of this singular type of organ will be discovered.

A BLIND PRAWN FROM THE RIVER OF LETHE.

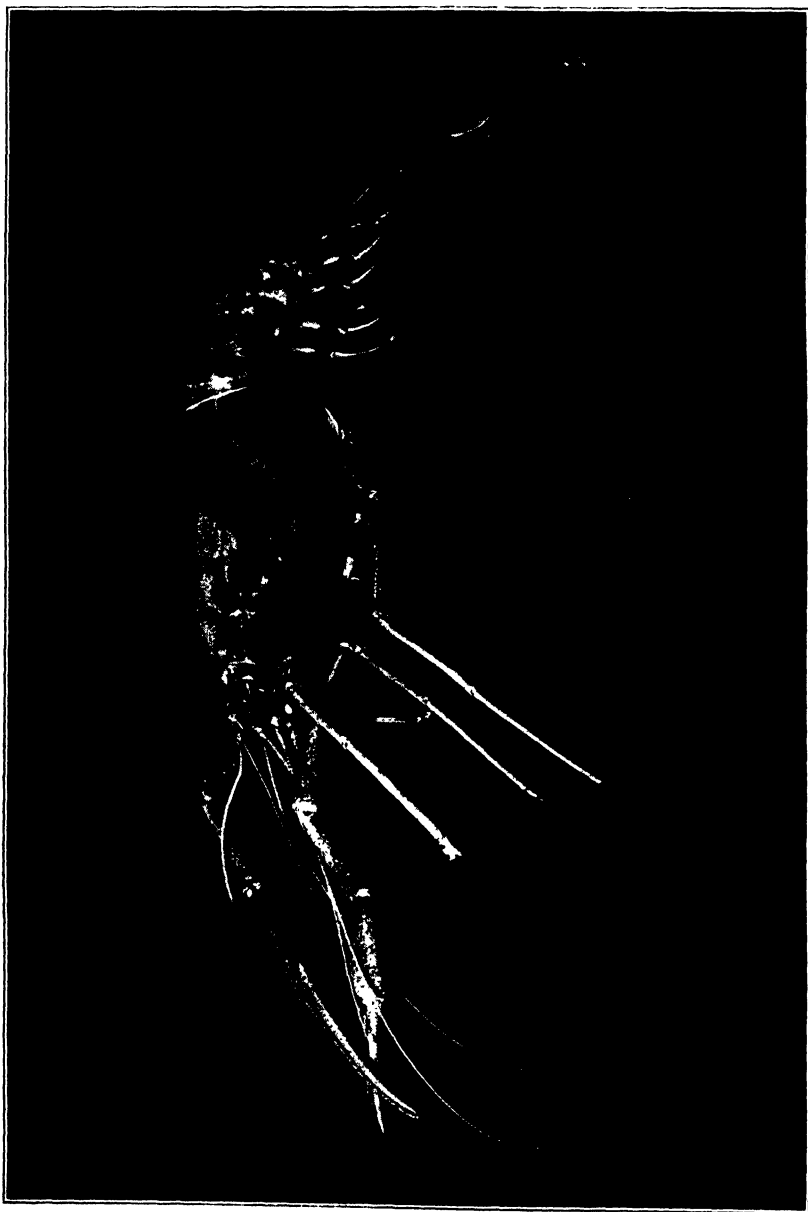
By W. T. CALMAN, D.Sc., F.R.S., Keeper of Zoology.

BLIND Crustacea have been found in many parts of the world, living in the underground waters that are accessible in wells or caverns or brought to the surface in springs. The little amphipod known as the "Well-shrimp" in England and the blind Crayfish of the Mammoth Cave in Kentucky are well-known examples.

The genus *Typhlocaris* was established for a remarkable blind Prawn which was sent to the Museum some seventeen years ago from Tiberias, in Palestine. It was found in a Roman tank fed by a mineral spring, and was known to the Bedouin of the district by an Arabic name meaning "White scorpion." In 1920 a second species was discovered by an Italian naturalist in Cyrenaica and was described by Dr. Parisi of Turin, by whom a co-type was presented to the Museum. A third species has since been discovered near Otranto, but has not yet been fully described.

Mr. H. Chaworth-Musters has recently presented to the Museum a fine series of the African species collected by himself in the original locality. This is a cave near the city of Bengazi (the ancient Berenice) in Cyrenaica, known to the Italians as "Grotta del Lete" and containing a stream or pool which is said to have been identified in classical times with the River of Lethe. The country round Bengazi is a rocky limestone plain with many "solution cauldrons," the fertile plots in which are the veritable "Gardens of the Hesperides." There are also numerous caverns of varying extent, some of which give access to underground waters. The whole country is said by Mr. Chaworth-Musters to be "very reminiscent of the 'karso' of the Trieste and Dalmatian region." The blind Prawns are probably widely distributed in the underground waters, for Mr. Chaworth-Musters obtained specimens from another cave about two kilometres distant from the Grotta del Lete. The water is brackish to a degree which varies with the season of the year, but an analysis of a sample by Mr. E. V. Holt of the Imperial College of Science does not suggest a direct communication with the sea. The temperature of the water at the time of Mr. Chaworth-Musters' visit was 21° C., that of the air being 15° C.

Typhlocaris resembles roughly in size and shape the common Prawn of our coasts (*Leander serratus*), although there are some conspicuous differences. The colour is a uniform translucent white, without any trace of the bands and spots which decorate the body and limbs of the common species. The pincer-claws



A BLIND PRAWN FROM THE RIVER OF LETHE (*Typhlocaris lethæa*).

formed by the second pair of feet are much larger than in the common Prawn, although they are not so disproportionately large as they are in many of the tropical River-Prawns. The beak or rostrum, which in most Prawns projects from the front of the carapace, is represented only by a little triangular spike. Most remarkable of all, however, is the condition of the eyes. Whereas in most Prawns the eyes are large, black and set on movable stalks, in *Typhlocaris* the stalks are reduced to a pair of small flattened scales in front of the head, quite colourless, and showing, on close examination, no trace of eye-structure. Among many other differences it may be noticed that the limbs, particularly the large claws, are covered with long slender hairs standing stiffly out from the surface. We know that the hairs on the surface of the body and limbs are in Crustacea the organs of the sense of touch, and it is tempting to conclude that they are more strongly developed in *Typhlocaris* to make up for the loss of the sense of sight. Actual knowledge of the habits and reactions of subterranean animals is, however, extremely scanty.

Typhlocaris belongs to the family Palæmonidæ, which includes among many other forms the common Prawn of British coasts and the large River Prawns of tropical countries. It has so many peculiar features that it has been placed in a separate sub-family, Typhlocaridinæ. As to its origin, nothing very definite can be suggested. In other parts of the world several species of Palæmonidæ have taken to a subterranean life, and some of them, at least, appear to be derived from species that were already inhabitants of fresh water. The remoteness of *Typhlocaris* from the other members of the family, expressed by its separation in a sub-family, suggests an ancient origin, probably from marine ancestors. The distribution of the three species at present known, round the shores of the Eastern Mediterranean, may point to a centre of origin in the lake or inland sea that once occupied that basin, but it is not unlikely that further search may show that the genus has a wider range.

PARASITES OF WHALES.

By H. A. BAYLIS, M.A., D.Sc., Assistant, Department of Zoology.

THE whale tribe, like all other animals, have their share of "uninvited guests" which live in or on their bodies. As might be expected, most of their parasites are peculiar to them, owing

to the mode of life of the hosts; but, while some of the parasites are related to forms which inhabit other kinds of marine hosts with similar feeding habits, others indicate the relationships of whales to land-mammals. This is especially true of a group of thread-worms which live in the air-passages and blood-vessels. These are clearly allied to the lung-worms (*Metastrongylidæ*) of Ungulates and terrestrial Carnivores. In some species of porpoises and dolphins almost every individual is infected with these worms. There is some reason for believing that infection is passed on before birth from mother to offspring, and this would explain why each species of this group appears to be almost confined to a single kind of whale.

One might expect that internal parasites would bear some relation in size to their hosts. This, however, does not appear to be the case. It is true that one or two whale-parasites are giants of their kind. A tapeworm, *Diplogonoporus balænopterae*, occurring in some of the large whales is, with the exception of one from the rhinoceros, probably the broadest species known. It attains a width of about an inch. The Trematode, *Lecithodesmus goliath*, is one of the largest known species, reaching a length of about 3 inches. But on the whole the parasites of Cetacea are not larger than those of other animals.

It is an interesting fact that some of the parasites of the intestine of the larger whales have developed remarkably powerful mechanisms for anchoring themselves to the host. It seems as if they were liable to be swept away by unusually strong peristaltic movements of the intestine. There are several forms of *Acanthocephala*, or "thorny-headed worms," which have developed large bulb-like expansions of the anterior end, with or without an armature of spines, and capable of being buried deeply in the lining of the host's gut. One of the tapeworms (*Priapocephalus*) has likewise, and quite independently, developed a similar bulb-like "holdfast," having at the same time lost all traces of the suckers normally present in related forms. These internal parasites have adopted the same device as the curiously-modified crustacean, *Pennella*, which lives on the skin of whales and, in order to resist the rush of water as the host swims, buries its head and neck deeply in the skin and blubber.

Most of the parasites of whales are profoundly modified in various ways in accordance with their mode of life. But one little Nematode worm (*Odontobius*), which lives in colonies on the whalebone in the mouth of whales, shows no special modification at all as the result of its semi-parasitic habit, but looks exactly like hundreds of its free-living relatives.

One parasite of man, the broad tapeworm (*Diphyllobothrium latum*), has been recorded from the porpoise, as well as from seals, the walrus, and various terrestrial Carnivores.

AMBICOLORATE FLATFISHES.

By J. R. NORMAN, Assistant, Department of Zoology.

As their name implies, the Flatfishes have a strongly compressed body, and both the eyes are placed on the same side of the head, the right side in some species (*e.g.* Plaice, Dab, Sole), the left side in others (*e.g.* Turbot, Brill). The blind side of the fish is normally white, but the upper or eyed side is coloured and generally bears a marked resemblance to the ground on which the fish lies. In many Flatfishes specimens are frequently discovered which are more or less coloured on the blind side as well as on the eyed side. This colouring may take the form of scattered brown or black spots on a white ground, or the hinder part of the fish may be coloured exactly like the eyed side. In the Plaice, for example, the pigmentation of the blind side includes even the red spots which are so characteristic a feature of this fish. Often the pigment extends over the whole of the body, only the head remaining white, and in rare cases even this also is coloured on both sides.

This phenomenon, which is known as ambicoloration, is of particular interest. It is known that the Flatfishes are descended from symmetrical fishes of the Sea-Perch kind, and it has been observed that complete (or nearly complete) pigmentation of the blind side is invariably accompanied by other variations towards symmetry. The skin and scales of the blind side not only assume the colour of those of the eyed side, but also resemble them in their structure. In the Dab, for example, the edges of the scales on the upper side of the body are spiny, and of those on the blind side smooth; in ambicolorate specimens the scales occupying the pigmented area on the blind side are also provided with spines. The bony tubercles scattered over the eyed side of the body in the Turbot are a characteristic feature of this species; in ambicolorate examples the tubercles are also present on the blind side (Figs. 1, 2).

In all Flatfishes the young fish when hatched has an eye on each side of the head and swims at the surface of the sea. After

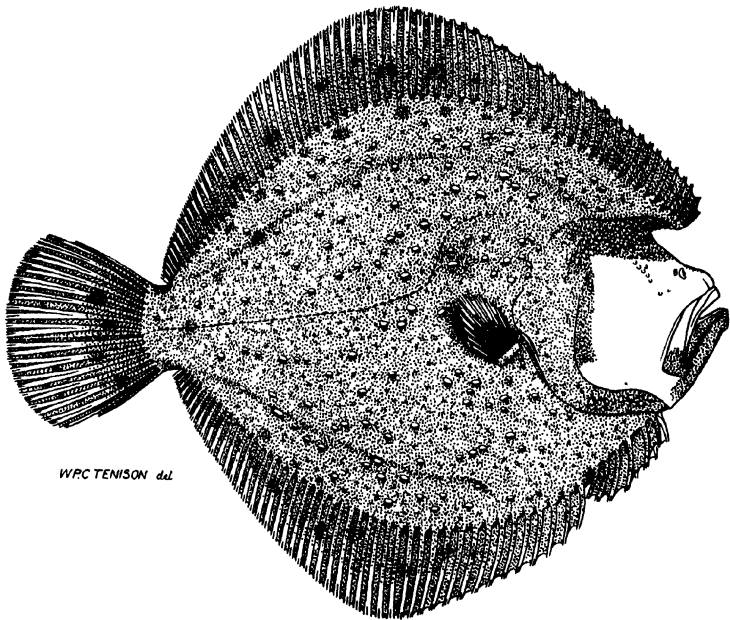


FIG. 1.—AN AMBICOLORATE SPECIMEN OF THE TURBOT (BLIND SIDE).

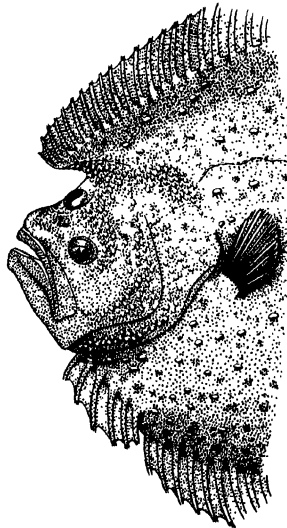


FIG. 2.—HEAD OF THE SAME SPECIMEN (EYED SIDE).

a time, however, it falls to the bottom, and one of the eyes moves round the top of the head until it comes to lie close to the other on the upper side. In ambicolorate Flatfishes this migration of the eye is arrested or delayed, so that when the time comes for the dorsal fin to grow forward the eye is on the top of the head and obstructs its progress. As a result, the fin grows forward as a fleshy hook above the eye. This hook is a very characteristic feature of all completely or nearly completely ambicolorate fishes, but is not developed in those which are only partially pigmented on the blind side.

Among a collection of Flatfishes recently received by the Museum from the Australian Government was a totally ambicolorate specimen of a species known in Australia as the Southern or Greenback Flounder. This fish belongs to a genus (*Rhombosolea*) characterized by normally possessing a single pelvic fin instead of the usual pair. In the ambicolorate fish, not only was the dorsal hook well developed, but two pelvic fins of similar form and equal size were present. It is of particular interest to find these variations towards symmetry which accompany ambicoloration affecting structures so important as the paired fins.

AN AQUATIC GLOWWORM.

By K. G. BLAIR, B.Sc., Assistant Keeper, Department of Entomology.

REPRESENTATIVES in warmer latitudes of the humble Glowworm of our countryside, the Fireflies form a brilliant feature of the tropic night; but, abundant and conspicuous though they are, the early stages of few of them are known. In those of which we have any knowledge the larva does not differ greatly from that of our English glowworm, but, like it, exhibits in many cases a light beneath the tail, frequents damp situations, and feeds upon snails. A few species, however, seem to have gone a step further, and, instead of preferring merely damp situations, have become definitely aquatic in habit and prey upon water-snails. An example of one of these found in the island of Celebes has recently been presented to the Museum by Dr. Malcolm A. Smith, whose attention was attracted to bright points of light at the bottom of a swift mountain stream, two or three feet in depth. With some difficulty two of the light-bearers were secured, and proved to be glowworm larvæ, not unlike those of our English species. The interesting point about them, how-

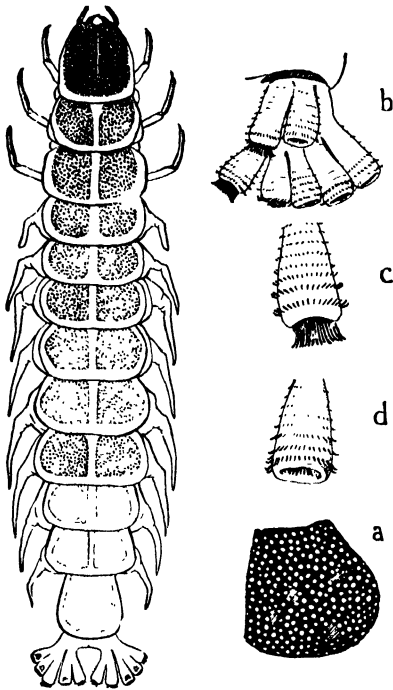
ever, was that they were provided with a row of slender gills along each side of the body, recalling those of the larva of the Whirligig Beetle (*Gyrinus*) or the Alder-fly (*Sialis*).

Two instances were previously known of aquatic larvæ in this family of Beetles. Both were met with in pools of standing water, in the one case in the neighbourhood of Calcutta and in the other in the Malay States.

In captivity, both remained at the bottom during the day, coming to the surface only at night. For breathing purposes the Calcutta larva was provided with a respiratory cup at the tail end, exposed to the atmosphere on the surface of the water, very similar to the arrangement found in the larvæ of the Hydrophilid water-beetles, or in those of mosquitoes. The Malay larva, however, had no special breathing apparatus; presumably in this case the interchange of gases that takes place in respiration is effected through the general integument of the body, as is not unusual, particularly in young larvæ, in many groups of insects.

It is thus remarkable that in this one family of beetles the only three known cases of aquatic larvæ should furnish us with examples of the three modes of respiration most commonly found amongst aquatic larvæ of all orders of insects.

Until the adult beetles are known, or at least until the three types of larvæ can be carefully compared, it is not possible to form an opinion as to whether these three types have developed from a single ancestor which took to an aquatic life, or whether each has been evolved independently. In order that some light may be thrown on this question, it is hoped that efforts will be made by those in a position to do so to rear these larvæ through to the beetle state. In the case of larvæ



AQUATIC GLOWWORM (? *Pyrophancs*).
a. Dorsal plate, 5th abdominal segment. *b.* Terminal grasping organ, ventral view. *c.* Single lobe of same with terminal hooks extruded. *d.* The same with terminal hooks retracted.

(By permission of the Entomological Society of London.)

living in standing water this should not be difficult, provided that care be taken to see that the larvæ are afforded means of leaving the water when fully grown, with access to moist earth or moss in which to pupate and complete their metamorphosis.

BOOK NOTICES.

The Elements of General Biology. By WILLIAM J. DAKIN. Pp. xvi + 496, with 252 text-figures. (Oxford University Press. 12s. 6d.)

PROF. DAKIN has written a remarkable book. He is among those who hold that a training in functional biology will serve the student better than the traditional intensive study of pure morphology. Consequently this book might almost as justly be called an elementary text-book of comparative physiology.

Following an opening section on the Protozoa, there is a chapter on elementary biochemistry; then a section dealing with nutrition, respiration, circulation, and temperature regulation, in which these functions are described in various types—the frog, the sheep, the crayfish and in several other arthropods. Chapter X is devoted to the animal skeleton, and this is followed by a chapter on the physiology of muscular activity and by one on animal locomotion. We are then switched off to a chapter on cytology leading to a short essay on animal histology. We next come to a section dealing with the nervous system and sense organs, which is more valuable than any other. We then have chapters on excretion, growth and reproduction, and animal development. Then follow sections treating of the fresh-water pond as an animal community (a little ecology had to be fitted in somewhere), symbiosis, commensalism and parasitism generally. There is a final chapter on evolution and heredity and an appendix dealing with laboratory technique and instructions for a practical course, followed by a short note on the endocrines.

From this brief summary of the contents it will be seen that Prof. Dakin has produced a very comprehensive compendium of biological knowledge; and the student who succeeds in absorbing it will acquire a vast amount of miscellaneous information. Prof. Dakin is at pains to emphasize the fact that zoology is also an experimental science, and at the end of every chapter there is described a series of simple laboratory experiments, many of which are ingenious and instructive.

The arrangement of the book seems very arbitrary. Why, for example, should the chapter on the cell come after those on respiration and muscular activity, and why should that on animal development be almost at the end of the book? Prof. Dakin has in many places omitted the long and detailed descriptions of structure which are a feature of most zoological text-books, on the ground that as much may be learnt from illustrations. We are inclined to doubt the wisdom of this because exercise in visualising a complex structure from an accurate description is an important part of the training of the young zoologist, unless he proposes to become a professional hypophysectomist, a branch of biology in which a knowledge of morphology is not required.

Much as we admire the breadth and variety of the book, we think that a thorough grounding in the structure of the several phyla of the Animal Kingdom would be of more use to the student than many of the things which Prof. Dakin

teaches him. There can be too much morphology, but there can also be too little. It is also questionable whether the student would from the arrangement of this book form any idea of the interdependence and interpretation of the various physiological processes described.

The illustrations on the whole are good: but we are forced to say that those which are original are the weakest.

Fogs and Clouds. By W. J. HUMPHREYS. Pp. xvii + 104, with 93 numbered and 3 unnumbered plates. (London: Baillière, Tindall and Cox. Baltimore: The Williams and Wilkins Company. 18s.)

MR. HUMPHREYS who is meteorological physicist to the United States Weather Bureau, is well qualified to write of the phenomena of moist air which according to their position are known as fogs (or mists) or clouds. It is a subject of obvious and immediate interest to every observant person, and perhaps not least to the inhabitants of these isles, where the weather is fickle and yet on the whole delightful. As the author tells us, the foundations of the science of nephology were laid by two Britons: Luke Howard, who was born in London in 1772 and died in 1864, and to whom we owe the cloud terms—cirrus, stratus, cumulus, nimbus; and John Aitken, who was born at Falkirk in 1839 and died in 1919, and who by ingenious and skilful experiments demonstrated clearly the mode of formation of the clouds.

The book is divided into five chapters which are respectively entitled: Evaporation and Precipitation, Fogs, Cloud Forms, Cloud Miscellany, Cloud Splendours, and it closes with a good bibliography and a copious index. A marked feature of the book consists of the large number of beautiful illustrations, mostly representing cloud scenes in the United States, and this wealth of plates explains what at first glance might seem a high price for a comparatively small book. Perhaps the most striking of all is the drawing of the magnificent solar phenomena due to ice crystals in the upper atmosphere seen at Aberdeen in 1921.

The book is one well worth perusal and study, and the author has the gift of writing of physical phenomena with a lucidity which enables a reader previously unacquainted with the subject to follow the reasoning without great difficulty.

STAFF NEWS.

THE Trustees recently lost by retirement the services of three of the senior members of the Staff, namely: Sir Sidney F. Harmer, K.B.E., Sc.D., F.R.S., Director, on March 9; Dr. C. J. Gahan, D.Sc., Keeper of Entomology, on January 20; and on the same date Mr. R. Kirkpatrick, Assistant Keeper, Department of Zoology, who also entered the Museum on the same day as Dr. Gahan, on September 1, 1886. Further, Mr. A. S. Hirst, Assistant Keeper, Department of Zoology, resigned his post on January 10 on account of ill-health.

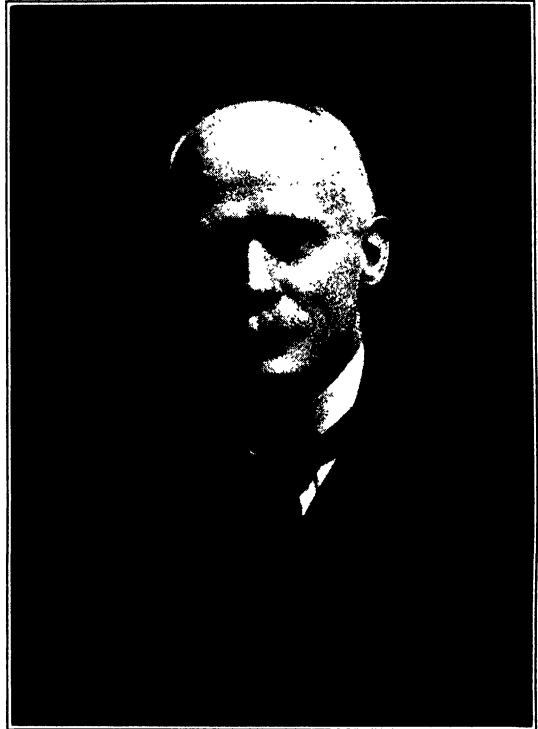
Sir Sidney Harmer, who was born on March 9, 1862, was educated at University College, London, and at King's College, Cambridge, where he obtained first-class honours in both parts of the Natural Sciences Tripos in 1882 and 1883 respectively. At University College, London, he was elected to

a fellowship in 1884, and at Cambridge he was lecturer at King's College in 1886 and Assistant Tutor from 1890 to 1908, and was Superintendent of the University Museum of Zoology and Comparative Anatomy from 1891 to 1908. On the appointment of the late Sir Lazarus Fletcher as Director of the Natural History Museum, the Keepership of Zoology, which had previously been combined with the Directorship, was separated from it and Dr. Harmer (as he then was) was appointed to the new post in 1909. Ten years later, in 1919, he succeeded to the Directorship on the retirement of Sir Lazarus Fletcher. Sir Sidney Harmer has paid special attention to Cetacea (Whales and Dolphins) and Polyzoa, in which groups he is a recognized authority, and is Vice-Chairman of the "Discovery" Committee appointed by the Colonial Office for the purpose of investigations mainly connected with whaling.

Dr. Gahan, who was born on January 20, 1862, was educated at Queen's College, Galway, and for two years, 1881-1882, studied under Huxley at the Royal School of Science, South Kensington, gaining the Edward Forbes Medal for biology in 1882. In 1886 he was appointed to an Assistantship in the Department of Zoology, and in 1913, on the separation of Entomology as a distinct Department, he became Keeper. His tenure of office has seen an enormous growth in the size of the Insect Collection and also a phenomenal development in the practical application of the science of entomology. Dr. Gahan has made a special study of insects injurious to timber.

Mr. R. Kirkpatrick, who was born on November 13, 1863, gained medical qualifications, but in 1886 he obtained an Assistantship in the Department of Zoology. He was in charge of the collections of a number of groups of the lower invertebrate animals, the most important of them being the sponges. He was frequently consulted by the authorities concerned in connection with the infestation of water-supply systems by undesirable organisms belonging to the groups of which he had special knowledge.

Mr. A. S. Hirst, who was born on November 6, 1883, entered the Museum as Assistant in the Department of Zoology in 1905. He has had charge of the group which includes spiders, scorpions, mites, and ticks, and became well known as an authority on those families of mites which are responsible for disease in man, domesticated animals, and plants. It is to be hoped that he

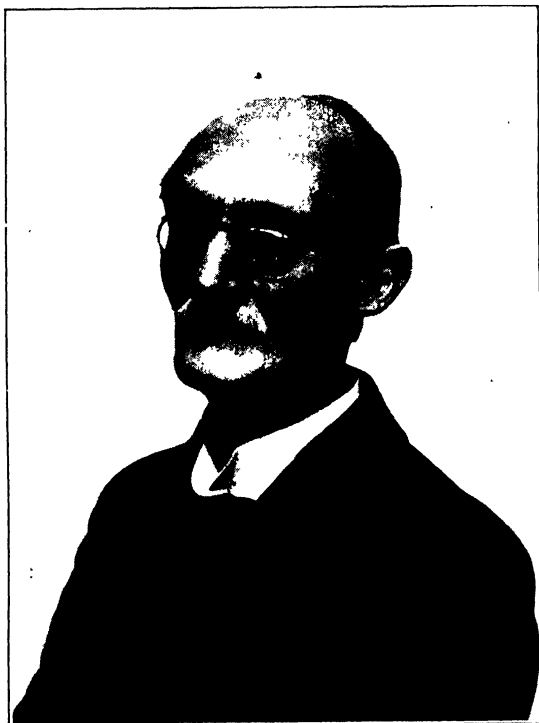


SIDNEY FREDERIC HARMER, K.B.E., Sc.D., F.R.S.,
who recently retired from the Directorship.

will find an opportunity of continuing his researches in the more genial climate which he has found it necessary to seek.

* * * * *

Mr. Charles Tate Regan, F.R.S., Keeper of Zoology, was appointed Director in succession to Sir Sidney Harmer. Mr. Regan was educated at Derby School and at Queens' College, Cambridge. He obtained a first class in Part I of the



CHARLES JOSEPH GAHAN, M.A., D.Sc.,
who recently retired from the Keepership of
Entomology.

Natural Sciences Tripos in 1900 and a second class in Part II in 1901. He obtained an Assistantship in the Department of Zoology in 1901 and was placed in charge of the collection of fishes. In 1919 he was appointed Assistant Keeper (or Deputy Keeper, as the office is now styled) on the retirement of the late W. R. Ogilvie-Grant, and in 1921 he succeeded Sir Sidney Harmer as Keeper of Zoology.

Dr. William Thomas Calman, D.Sc., F.R.S., who takes the place of Mr. Regan as Keeper of Zoology, was educated at Dundee High School and at University College, Dundee, in the University of St. Andrews. From 1895 till 1903 he was assistant lecturer and demonstrator in Zoology at University College, Dundee, and in 1904 he was appointed Assistant in the Department of Zoology and placed in charge of Crustacea. In 1921 he became Deputy Keeper in succession to Mr. Regan, whom he now follows as Keeper.

Dr. William Dickson Lang, Sc.D., has been appointed Deputy Keeper in the Department of Geology. Dr. Lang was educated at Christ's Hospital, Harrow School, and Pembroke College, Cambridge. He obtained a first class in the first Part of the Natural Sciences Tripos in 1901 and a second class in the second Part in 1902. He entered the Museum as Assistant in the Department of Geology in 1902 and has had charge of fossil corals, sponges, Polyzoa, and Protozoa. During the War he was temporarily transferred to the Department of Entomology, where he worked on mosquitoes and other insects of economic importance.

CORRIGENDA.

p. 2, line 17 from bottom, *for* Bankes's *read* Banks's.
p. 4, line 8 from bottom, *for* yards *read* feet.

A Selection of the more recent Works on Natural History, Guide-Books, Postcards, etc., published by the Trustees of the British Museum

Catalogues, etc.

- Monograph of the Voles and Lemmings (Microtinæ), Living and Extinct.** By MARTIN A. C. HINTON. Vol. I. Pp. xvi., 488 : 15 plates and 110 text-figures. [With Systematic and Alphabetical Indexes.] 1926, 8vo. £1 10s.
- Catalogue of the Selous Collection of Big Game in the British Museum (Natural History).** By J. G. DOLLMAN, B.A. Pp. vii., 112 : portrait of the late Capt. F. C. Selous, D.S.O. [With an Alphabetical Index.] 1921, 8vo. 7s. 6d.
- Catalogue of the Type Specimens of Lepidoptera Rhopalocera in the British Museum.** By N. D. RILEY and A. G. GABRIEL.
- Part I. *Satyridæ*. Pp. 62. 1924, 8vo. 4s. 6d.
- Part II. *Danaidæ*. Pp. 53. 1925, 8vo. 4s. 6d.
- A Monograph of Lichens found in Britain : being a Descriptive Catalogue of the Species in the Herbarium of the British Museum.** Part II. Second Edition. Pp. ix., 447 : 63 plates. [With List of Plates, Glossary and Index ; also an Appendix containing emendations and additions to Part I (Second Edition, 1918).] 1926, 8vo. £1.
- Catalogue of the Machæridia (*Turrilepas* and its Allies) in the Department of Geology.** By T. H. WITHERS, F.G.S. Pp. xv., 99 : 8 plates and 13 text-figures. [With Preface by Dr. F. A. BATHER, F.R.S., Table of Contents, General Index, and Explanation of Plates.] 1926, 8vo. 7s. 6d.
- Summary Guide to the Exhibition Galleries of the British Museum (Natural History).** Third Edition. [By C. TATE REGAN, M.A., F.R.S.] Pp. 16 : 3 plans and view of the façade. 1926, 8vo. 3d.
- Handbook of Instructions for Collectors, issued by the British Museum (Natural History).** Fourth Edition. Pp. 222 : 75 text-figures and 1 plate. [With Index.] 1921, 8vo. 5s.

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Natural History Magazine

No. 3

JULY, 1927

Vol. I

A HYAENA NEW TO THE EXHIBITION COLLECTION.

By J. G. DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

AMONG the specimens recently presented to the Museum by the Rowland Ward Trustees is a mounted example of the Brown Hyaena (*Hyaena brunnea*). No specimen of this comparatively rare animal has been previously exhibited in the Museum.



Photograph by

HYAENA.

Rowland Ward, Ltd.

The Brown Hyaena, or Strand Wolf as it was called by the early European settlers, was in former times quite common in South Africa, and proved itself a great pest to the farmers, destroying sheep and biting off the tails of cattle. This led to it being nearly exterminated in most of the cultivated areas. It is now comparatively rare in most parts of Africa south of the Zambesi, but is still fairly common in South-West Africa and extends northwards into Angola and Kenya Colony.

This specimen was mounted in the Rowland Ward studios.

OCEANIC ANGLER-FISHES.

By C. TATE REGAN, M.A., F.R.S., Director.

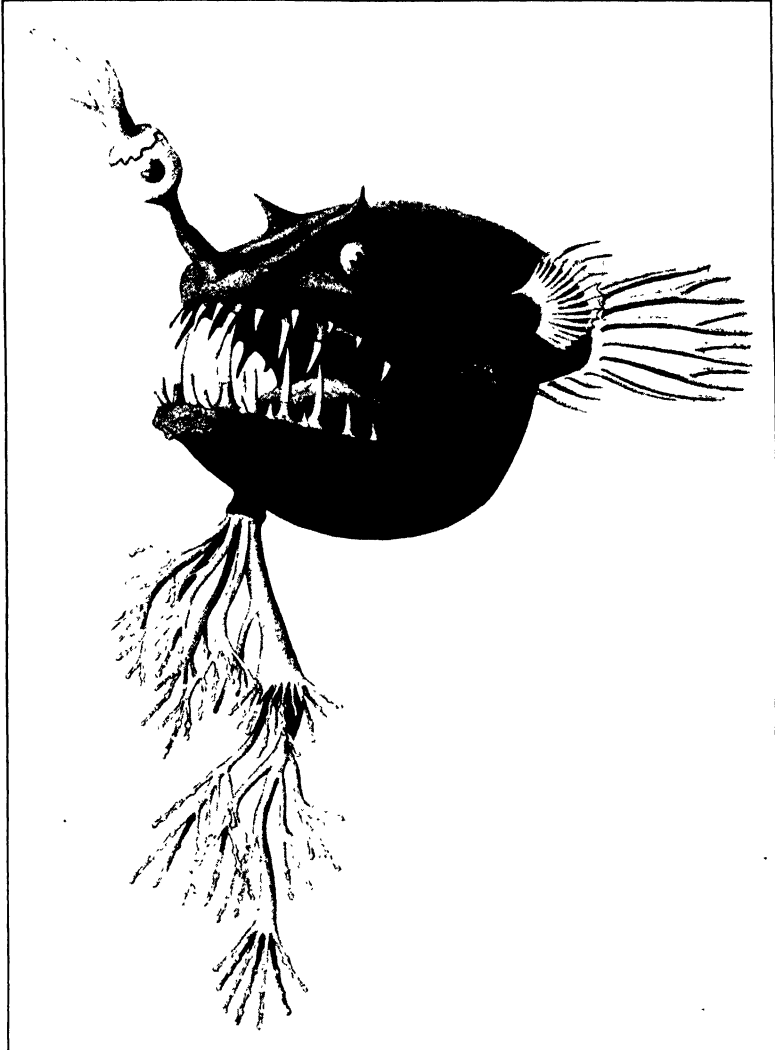
THE Angler-fishes are so named because the first ray of the dorsal fin is placed on the top of the head and is modified into a line and bait. All the members of the group are marine, and most of them live on the bottom in shallow or moderately deep water: these generally resemble in colour the ground on which they lie or the rocks and the weeds among which they lurk, and their bait is a flap or a tuft of filaments carried at the end of the first dorsal ray and moved about to attract prey.

The Ceratioids are Angler-fishes that live out in the ocean and in mid-water, inhabiting a region that extends from about 200 to 1000 fathoms (400–2000 metres) below the surface; here there is little or no light, and the majority of these fishes are uniformly blackish in colour and have the bait represented by a luminous bulb.

About fifty different kinds of these oceanic Anglers are known, and these exhibit an extraordinary diversity in form, in the structure of the luminous lure, in the size and shape of the mouth, and in the arrangement of the teeth. In some the lure is set directly on the head, in others it is at the end of a long line, which in one species is four times as long as the fish itself. This line, or first ray of the dorsal fin, is attached to the front end of a basal bone that as a rule lies in a groove on the top of the skull; in some forms this basal bone projects and may appear as a long rod, to the end of which is attached a line (Fig. p. 68), and in one genus (*Lasiognathus*) this line is prolonged beyond the bait to end in a triangle of hooks. The fishes of the genus *Linophryne* are remarkable for their "beard," which in the species figured is much branched and resembles a piece of seaweed: the use of this appendage is unknown.

In the Museum collection are three examples of a *Melanocetus*, an angler with a large mouth and strong teeth, each of which had succeeded in swallowing a Scopeloid fish (*Lampanyctus*) three times its own length and many times its weight. The *Melanocetus* seized its prey by the tail, and doubtless was at first content to hold on and be carried about by its struggling victim, until the latter got tired and began to be swallowed; for all the teeth of the *Melanocetus* are depressible, making passage inward easy, but preventing any attempt to escape by becoming erect. When the operation was completed

the *Lampanyctus* formed a complete circle inside the distended stomach of the *Melanocetus*, which had somewhat the shape of a balloon.

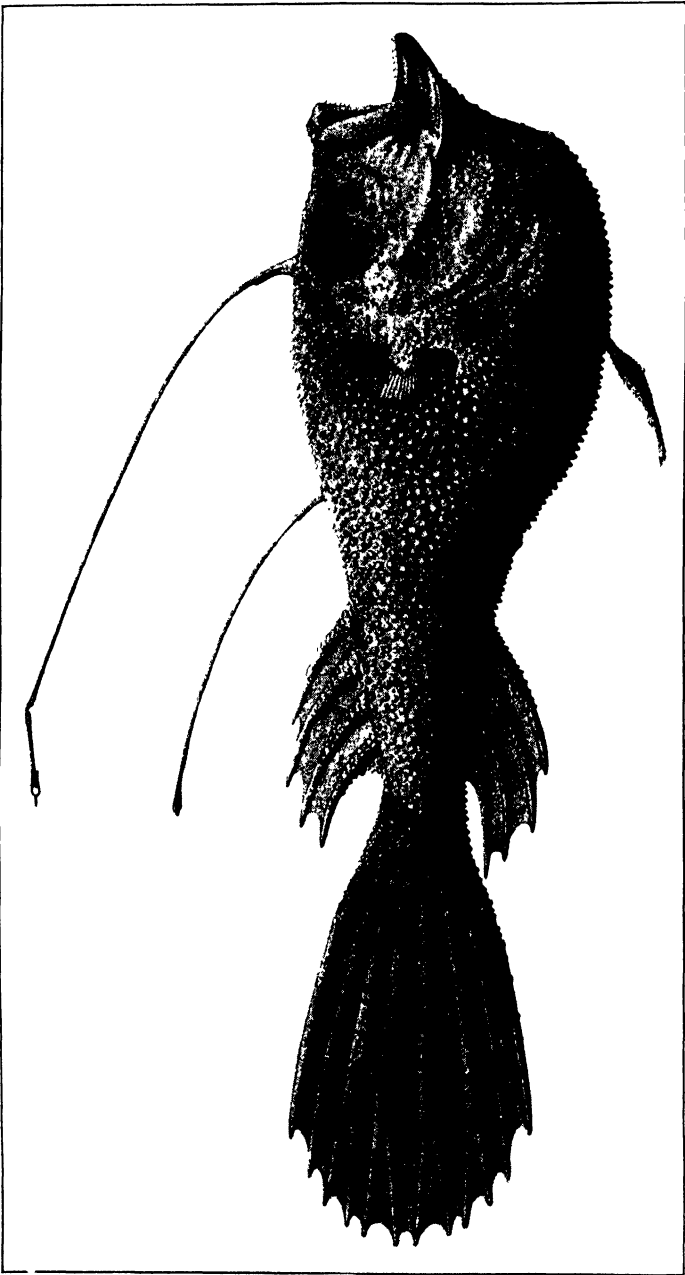


Drawing by

LINOPHRYNE ARBORIFER. Natural size.

W. P. C. Tension.

It has recently been discovered that in the Oceanic Angler-fishes all the free-swimming fish are females, and that the males are dwarfed and parasitic on the females. The Ceratioids are necessarily fewer in numbers than the more active fishes



W. P. C. Tenison.

CERATIAS HOLCELLI, $\times \frac{1}{6}$.
Female with parasitic male attached below the head.

Drawing by

on which they prey and attract by their luminous lure, and they live a solitary life, floating about in the darkness of the middle depths of the ocean. In these circumstances it would be difficult for a mature fish to find a mate, and this difficulty appears to have been overcome by the males, as soon as they are hatched, when they are relatively numerous, seeking the females, and if they find one, becoming attached to her and remaining attached for life. Probably the male first holds on to the skin of the female by his mouth, but the two fishes soon become so completely grown together that the male is a mere appendage, incapable of feeding himself, and nourished only by the blood of the female. Dwarfed males are known in some other groups of animals, but in none of these is the male both fixed to and parasitic on the female, and this kind of parasitism, by union of the blood-systems, is unique.

The Danish expeditions of the *Dana* (1920-22) obtained more than 200 specimens of Ceratioids from the North Atlantic and the Gulf of Panama, nearly four times as many as were previously known; these were caught in special mid-water nets towed at various depths below the surface.

An exhibit of Oceanic Angler-fishes has been placed in the Central Hall of the Museum. It includes a cast of a female Ceratias with a male attached to her, the wife, 40 inches (1 metre) long, being about 1000 times the weight of her husband. Enlarged models of the male illustrate its structure and the way in which it is united to the female. There are also models of a Melanocetus before and after swallowing a fish much larger than itself, and several drawings of some of the strange new types discovered by the *Dana*.

NOTE ON THE EVOLUTION OF THE VOLES (MICROTINÆ).

By M. A. C. HINTON, Assistant, Department of Zoology.

AMONG the recent publications of the Museum is the first volume of a *Monograph of Voles and Lemmings (Microtinæ), Living and Extinct*, by the writer. Voles and Lemmings are rodents forming the subfamily Microtinæ of the Muridæ (the great family which includes all the living and fossil rats and

mice), and they are of considerable interest to both the zoologist and the geologist.

The earliest remains of Microtinæ yet known are those which have been recovered from the later Pliocene deposits of Britain and the Continent; but there is reason to believe that the subfamily is of much more ancient origin, dating probably from Middle Tertiary or even Early Tertiary times. Thus the oldest known species are all fully developed Voles belonging to several genera, of which some still survive, and the subfamily, now represented by many genera and a large number of species, has a remarkably wide distribution, its range extending over the whole of Europe, the greater part of Asia (including Japan), and the whole of North America; from Algeria, Tunis, Palestine, the Himalayas, Yunnan, and Guatemala northwards; and from the sea-beach in both hemispheres upwards to the limits of terrestrial life within the Arctic Circle or towards the summits of the highest mountains. This distribution and the apparent absence of any trace of the group in the older Tertiary deposits of Europe and North America appear to indicate that the subfamily originated either in Northern Asia or else in high northern latitudes, which are known to have enjoyed a genial climate during Tertiary times. By gradually acquiring the power of subsisting upon coarser, tougher, less inviting and less nutritious vegetable substances than those usually devoured by rival groups of Muridæ, the Microtinæ have tapped vast and never-failing food supplies; this change of diet has not only enabled the Microtinæ to survive in the face of keen competition and to colonize the Holarctic region with unusual thoroughness, but it has brought about the gradual development of all the more striking peculiarities of external form and internal structure now possessed by the subfamily. So much of the new food (roots, bark, grass, and moss) occurs on or below the surface of the soil that nearly all the Microtinæ have become strictly earth-bound creatures, more or less specialized for burrowing; compared with the more generalized and more agile Murinæ, Voles and Lemmings are clumsily built, thick-set creatures, with blunt noses, shortened ears, limbs and tails, and reduced eyes. Some of them have become completely fossorial, leading the lives of "rodent-moles"; the Lemmings and a remarkable Vole, *Prometheomys*, inhabiting the Caucasus, use their hands, armed with unusually powerful claws, as their chief tools in digging, just as the Mole does; other genera, such as *Ellobius*, use their incisor teeth and skulls as picks and shovels. Many of the fossorial Microtinæ have mole-like coats. Other genera,

such as *Ondatra*, the well-known Musquashes of North America, or particular species such as the Water Vole, are more or less highly modified for aquatic habits.

The chief structural modifications of the Microtinæ, however, are those which have been directly occasioned by the nature of the new food itself. Tough vegetable fibres, rich in cellulose, make greater demands upon the digestive organs than do more succulent substances. The cheek-teeth, which were lightly built, low-crowned, multituberculate, and rooted, in the primitive ancestors of all Muridæ, have become transformed gradually in Microtinæ into heavy, tall-crowned, prismatic teeth, provided with peculiarly curved cutting blades of hard enamel, and held in place in the jaws chiefly by their opposed curvatures and special ligaments. In the highest forms these teeth never develop roots at all, but become endowed, like the incisors of rodents, with the remarkable power of persistent growth. When quite unworn the cheek-teeth of Microtinæ commonly show, however, remnants of the primitive tubercular cap, and in some of the less specialized genera they still develop roots as old age advances. In primitive Muridæ the lower jaw during mastication moves in a vertical and lateral direction, the food being reduced chiefly by crushing; but in Microtinæ the motion has become longitudinal, the food being cut to pieces between the curved enamel blades of the cheek-teeth. The jaw muscles have become unusually powerful and to some extent rearranged for their altered functions. The skull, under the combined influence of the heavier and larger cheek-teeth and the more powerful muscles, has become unusually strong and massive, quite unlike the delicate skull of the ancestral forms; many bones which in primitive Muridæ remain distinct throughout life, fuse together, sometimes even before birth, in the skulls of Microtinæ.

SOME STRANGE RELATIVES OF THE FROG-HOPPER OR CUCKOO-SPIT BUGS.

By W. E. CHINA, B.A., Assistant, Department of Entomology.

NEARLY everyone is familiar with the conspicuous accumulations of froth which are to be seen on the tender shoots of most plants in spring and early summer. The sudden appearance everywhere of this spittle-like froth at the time of the

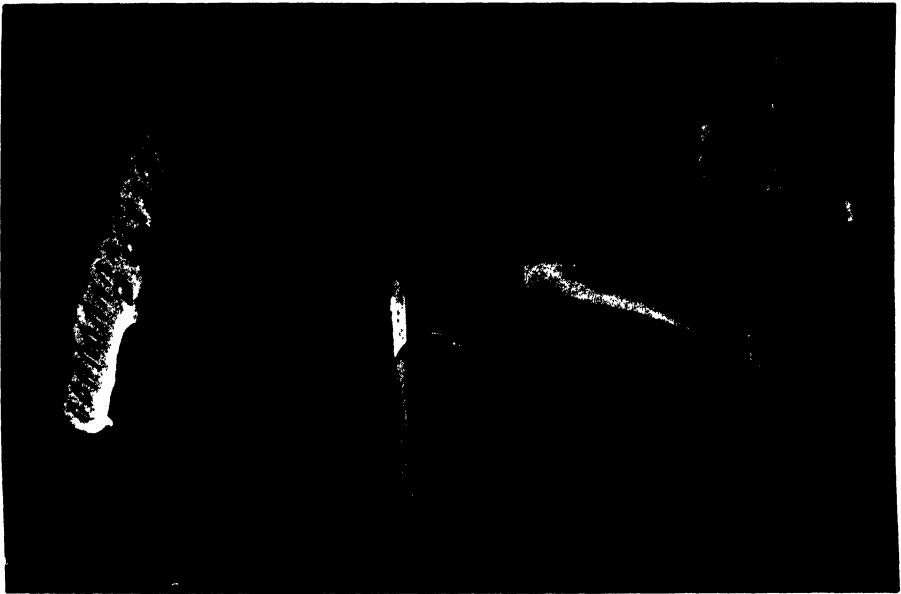
cuckoo's arrival has given rise to the popular name Cuckoo-spit, but, as many people are no doubt aware, this "spit" has nothing to do with the cuckoo, and merely harbours a soft, greenish-yellow insect, which sucks the sap of the plant on which it rests. The little creature in question is, in fact, the immature, or larval, stage of the much less conspicuous Frog-hopper bug, which is abundant on vegetation everywhere later in the year, and the popular name of which is due to the rather vague resemblance of its head to that of a frog and to its tremendous power of jumping when disturbed. There are several different kinds of Frog-hoppers in Britain, but the common garden species * is perhaps the most widely distributed of them all, and is indeed one of the commonest and most widespread of all British insects, being just as abundant in London gardens as it is in the wildest and most inaccessible regions. This is probably due to the fact that it has few enemies, and is as much at home on a wayside weed as on a choice rose bush. It occurs throughout Europe, and also in North America. In spite of the excessive prevalence of this species, its life history in this country is not known with any certainty, and until comparatively recently the early stages had escaped observation. The young bugs simply appeared in spring, surrounded by their protective froth, and proceeded to develop gradually into adults, as is the custom of all bugs.

Some years ago, Dr. C. J. Gahan found a number of eggs in rows under the thin peeling bark of a vine growing in his garden. These he assumed to be the eggs of the common Frog-hopper, and his assumption was confirmed in 1921 when two American entomologists, Messrs. Barber and Ellis, confined adults in cages with growing grass plants, and in this way obtained eggs. The eggs were laid between the stalk and the cylindrical base of the leaf, and were arranged in single rows, side by side, each egg being placed obliquely and embedded in a dry, tough, frothy material, the whole row being also surrounded with the same protective substance (Fig. 1). This is quite an unusual method of egg-laying in this group of bugs (Homoptera), the eggs being usually inserted into the tissue of the plant by means of a powerful ovipositor. In this country the females seem to prefer crevices in dead broken stems of herbaceous plants, but all kinds of situations are made use of. The eggs observed in America were laid in August, but here egg-laying probably takes place much later; in fact, eggs have been obtained in captivity as late as November, and mating commonly takes place in October.

* *Philænus spumarius*, Fallen.

Adult females may be found, especially on garden chrysanthemums, well into November, but it is unlikely that these hibernate, there being no records of adults being captured during the winter months. On the other hand, assuming that the eggs are generally laid in the autumn, the manner in which the delicate, newly-hatched larva finds its way, often many yards, across well-dug garden beds to recently established plants has yet to be explained.

Although so little work has hitherto been done on the life-cycle of the Frog-hopper, numerous investigations have been



Photographs by

V. Friche.

FIG. 1.—EGGS OF THE FROG-HOPPER OR CUCKOO-SPIT BUG (*Philænus spumarius*, Fallen).

Left, a row of eggs on the withered petal of a dead chrysanthemum flower; right, a row of eggs beneath peeling bark of a dead stem (enlarged); the latter, slightly less than natural size, in centre.

made into the method by which the “grub” covers itself with foam. In the majority of cases, however, incorrect interpretations were attached to what was seen, even Fabre, usually so careful an observer, being led astray on this point. Thanks to the work of Morse, Guilbeau, Šulc, and Brocher, the method of froth formation is now fairly clear, and can easily be understood by a study of the following simplified account.

In the first place there is an air space, or channel, down the under-side of the abdomen of the insect, formed by the overlapping of the plate-like lobes, or processes, into which the

downwardly curved sides of the abdomen are expanded (Fig. 2*a*). Into this air space open the breathing pores, or spiracles, two in each segment. The liquid, which is perfectly clear at first, comes exclusively from the intestine (Fig. 2*b*), and consists of the unassimilated portion of the sap, which is being sucked by the larva from the plant, together with waste products. This clear

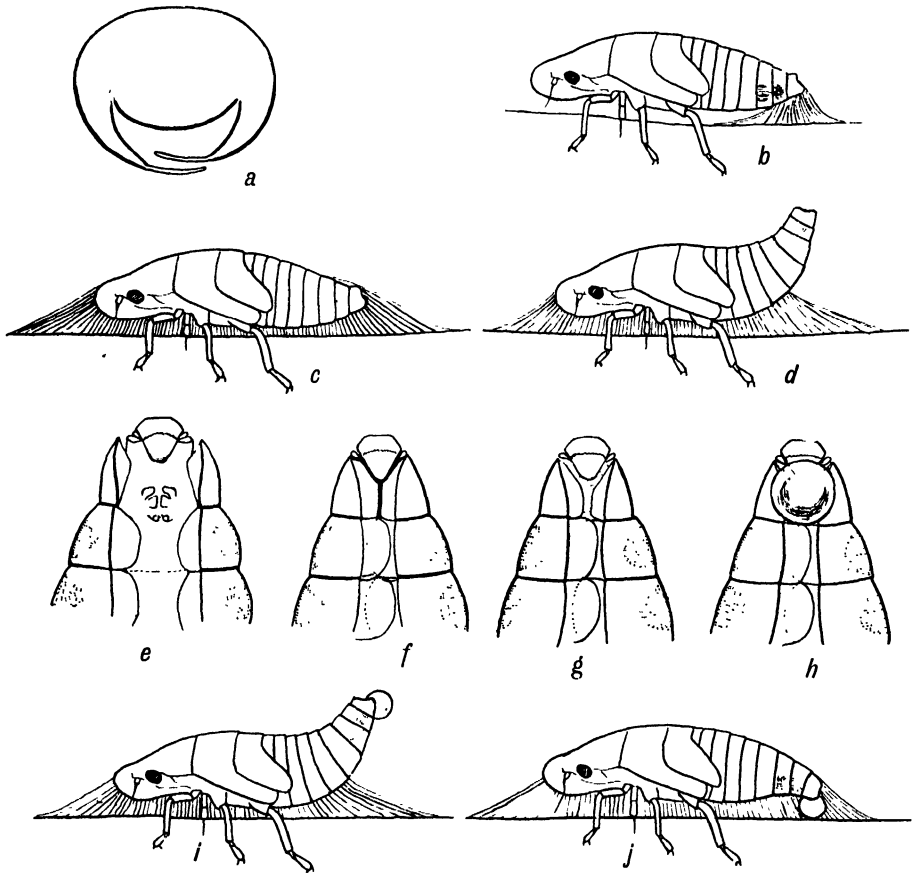


FIG. 2.—METHOD OF FROTH FORMATION IN THE COMMON FROG-HOPPER OR CUCKOO-SPIT BUG (*Philænus spumarius*, Fallen). For explanation see text.

liquid flowing from the anal orifice covers the under-side of the body, and fills the space between the latter and the surface of the plant, so that the young Frog-hopper is standing in a small pool of clear liquid (Fig. 2*c*).

On the sides of the 7th and 8th abdominal segments, that is, near the tip of the abdomen, are patches of glandular cells (Batelli's glands), which secrete through minute pores a waxy

substance. This mixes in some way with the clear liquid to form a viscous fluid capable of retaining for a considerable period the bubbles of air which will later be formed. According to Šulc, the wax is dissolved by an enzyme (lipase) in the anal excretion, and is converted by the alkali, also present in the fluid, into a soap, which produces the desired viscosity.

The insect now stretches its abdomen upwards out of the liquid (Fig. 2*d*), opening wide the air channel by separating the previously overlapping lobes (Fig. 2*e*). A supply of fresh air is thus taken into the air channel sufficient for respiration and bubble blowing.

The lobes are now brought together again, closing up the air channel (Fig. 2*f*), and the stream of liquid from the anal orifice flows over the crack between the two end lobes, which never overlap, but simply touch one another. The two end lobes are now slightly separated (Fig. 2*g*), causing the liquid to be stretched out in a fine film over the narrow Y-shaped opening so produced. By the contraction of the abdominal segments, air from the air channel is now forced out through the Y-shaped opening, stretching the liquid film out into the form of a bubble (Figs. 2*h* and 2*i*). At the same time the tip of the abdomen is rapidly lowered into the pool of liquid (Fig. 2*j*), where the bubble becomes detached and incorporated into the liquid. This procedure is rapidly, but regularly, repeated, the tip of the abdomen being lowered first on one side and then on another, until the pool of liquid becomes a mass of bubbles. The insect uses its legs to spread the bubbles around it, and sufficient froth is formed to cover the creature entirely.

When it undergoes its periodical moults, it forms an air cell around it in the centre of the froth, by breaking up the inner bubbles which have apparently dried. This cell is particularly noticeable during the final moult when the adult is emerging from the last larval skin. In this cell the at first soft greenish-yellow adult remains until its tissues harden, and its colouring matures. The larvæ change their position on the plant from time to time, so that several froth masses are formed.

The Frog-hoppers of the group * to which our common one belongs are nearly always dull in colour, being frequently dirty yellow or green, mottled and marked with brown. In very few cases is the full life-history known, but it would appear that the group is characterized by the production of froth masses on the aerial shoots of plants. The question arises as to how the members of this group manage to maintain their frothy

* Aphrophorinæ.

protection in hot dry countries, and in the Western United States it has been found by Dr. Ball, an American entomologist, that two species overcome this difficulty in a different way. In one species *(1) the larvæ are gregarious, and live together surrounded by their froth in the shelter of the large swollen leaf bases of the giant umbellifer, *Heracleum lanatum*.

The adult of the other species (2) normally lives on pine trees, but, when the time for egg-laying arrives, the female leaves the pines, and flies to neighbouring tufts of low growing herbs (2a), where she deposits her eggs. The resultant larvæ form their froth masses at the base of the stems in the centre of the plant, some even working their way below the surface of the ground. This brings us to the next and largest group (3) of Frog-hoppers, the larvæ of which are more or less subterranean, sucking the roots of plants, and forming their froth masses in crevices in the soil amongst the root fibres. The adults are almost always brightly coloured, and there is one handsome scarlet and black British species (4) of this type, which is fairly common in suitable localities in Southern England. Nothing is known of its life-history beyond the fact that the larvæ pass the winter underground, sometimes as much as twelve inches below the surface of the soil. The best-known species of this group, however, is the Sugar-cane Frog-hopper of Trinidad (5), the larvæ of which live on the roots of the canes. This insect is said to be responsible for an average yearly loss of £55,000, and in the season 1916-17 its activities caused a diminution of crop which resulted in a financial loss estimated at £300,000.

We have seen how the larvæ of one group of spittle bugs produce froth masses on the shoots of plants, whilst those of another group, which has its headquarters in tropical countries, develop them underground. There still remains another small, but remarkable, subfamily (6), the larvæ of which live in a very different manner. These strange relatives of the Frog-hoppers are natives of India, the Malay Archipelago, and Australia. The adults exhibit much more variety of form than those of the previously mentioned types, and in some species the thorax is extended upwards into a long curved spine. All agree, however, in having larvæ which live in calcareous tubes attached to the twigs of their food plants, and varying in shape and method of attachment in different species. The larva lives in the tube

* (1) *Aphrophora angulata*, Ball. (2) *Aphrophora permutata*, Uhler. (2a) *Chrysopsis villosa* and *Lupinus* Sp. (3) Cercopinæ. (4) *Triecphora vulnerata* (Illiger). (5) *Tomaspis saccharina*, Distant. (6) Machærotinæ.

head downwards, covered with a clear liquid which, as in the common cuckoo-spit insect, issues from the anal orifice, and it feeds by sucking sap through a longitudinal slit in that side of the tube which rests against the twig. Of the life-history very little is known. The first observations were made in 1885 on some Australian species * (Fig. 3f) by F. Ratte, a French naturalist residing in Sydney, who described three different kinds of tube, all found on twigs of various species of *Eucalyptus*.† Two

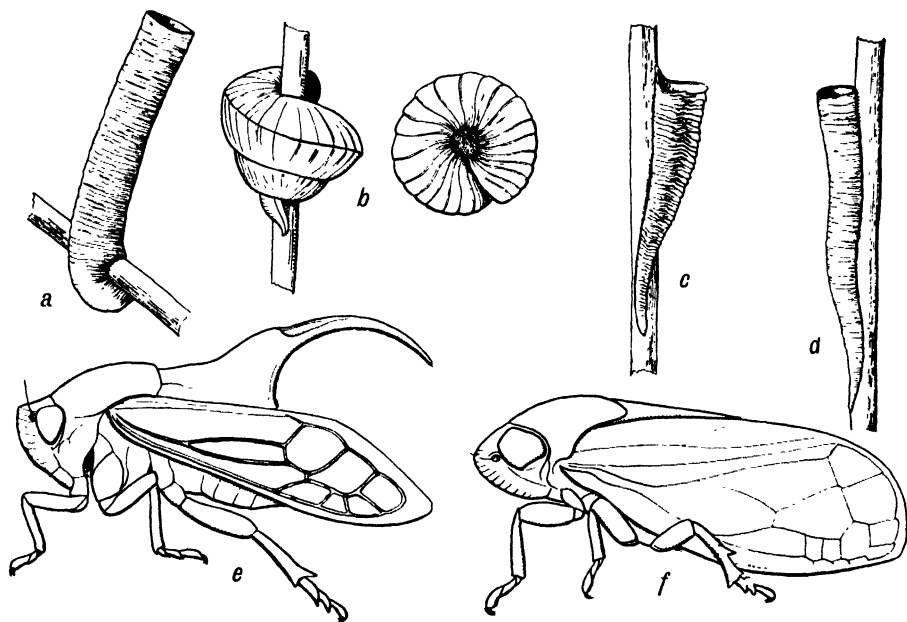


FIG. 3.

a-d. Calcareous Tubes of various Tube-dwelling Frog-hoppers (Cercopidae). For explanation see text.

e. An Adult Ceylonese Tube-dwelling Frog-hopper (*Machærota guttigera*, Westwood).

f. An Adult Australian Tube-dwelling Frog-hopper (*Pectinariophyes pectinaria*, Kirkaldy).

forms were long, straight, conical and fairly common (Fig. 3c and 3d), but the third was rare and of a remarkable type, being curled round a twig in a helicoid spiral (Fig. 3b). By rough experiment, Ratte estimated that the substance of which the tubes were made consisted of about 75 per cent. of calcium carbonate. This he naturally assumed was extracted from the sap of the *Eucalyptus*. With regard to its habits he wrote: "The

* *Pectinariophyes pectinaria*, Kirk. (Fig. 3f), and *Polychætophyes serpulida* Kirk.

† *Eucalyptus hæmastoma*, var. *micrantha*, and *Eucalyptus capitellata*.

insect occasionally moves itself backwards, and emits a drop of clear water at the entrance of its shell, which is habitually half or nearly full of water. In warm weather especially, the production of water is increased, and drops are seen falling from the top of the shell." In one species (*Polychætophyes serpulida* Kirk.), he pointed out that the larva is provided with a broad, circular plate at the end of the abdomen, which acts as a lid with which to close the entrance of the tube. The adults make little use of their wings, but can jump, and run, very quickly. The tubes are found from two to seven feet above the ground. Ratte noticed that when emerging from



FIG. 4.—THE EMERGENCE OF AN AUSTRALIAN TUBE-DWELLING FROG-HOPPER (*Polychætophyes serpulida*). After Hacker, *Memoirs of the Queensland Museum*.

the tube for the final moult the larvæ surrounded themselves with a frothy mass similar to that of the Cuckoo-spit bug. He estimated that the time spent in the larval state, and thus in the process of "growing" the tube, was about ten months. Mr. Henry Hacker, of the Queensland Museum, who has recently described the emergence in some detail, states, however, that there are two broods in the year. According to Hacker, emergence takes place in early spring, usually in the evening. The larva protrudes the tip of its abdomen from the tube for about a second at regular intervals, taking in a supply of air and blowing bubbles apparently in much the same way as does the common Frog-hopper. When sufficient froth has been formed

at the entrance, the insect backs out of the tube, swings itself over the side, and rests with its head pointed upwards in the mass of froth, which has run over and accumulated there. Within this froth the final moult is made. The froth having subsided, the wings are rapidly expanded, and two hours after the first appearance of froth the change is complete. Mr. Hacker's paper is illustrated with beautiful photographs, some of which are reproduced here (Figs. 4 and 5).

In 1886, Prof. Westwood published an account of the tubes formed by a Ceylonese species * of this group on the twigs of the Suriya tulip tree,† from observations made by Mr. Staniforth Green, of Colombo. This statement, though naturally differing in detail from those of Ratte and Hacker, respecting the Australian forms, is the same in essentials, but throws some light on the method of tube formation. The tube in this species is perfectly cylindrical, with the base curled around a twig, and the greater part standing out perpendicularly (Fig. 3a); it is thus impossible for the creature to suck sap through the sides of the tube. Green wrote that the insect seemed to be continually working the tip of the abdomen against, and around, the inside of the entrance of the tube, discharging at intervals clear liquid from its intestine; when some of the fluid was allowed to dry on a piece of glass, practically no residue was left. According to Green, water seems to drop from the tube day and night, for he noticed it dropping before sunrise. Some weeks are passed in the larval state, and the final change occurs early in the morning, shortly after sunrise. First of all a quantity of little bubbles appears in the form of a knob at the mouth of the tube. Then the creature comes out tail foremost, and takes up a transverse position on the top of the tube in the middle of the froth. In about ten minutes the mature insect has emerged from the larval skin, and the curved horn on its thorax seems to uncurl. One of the most striking features of many of these tube-dwellers is that the adults, as in this Ceylonese species, are provided with a very large, strong, curved horn, protruding from the back of the thorax (Fig. 3e); it seems extraordinary that a creature which has to develop within the narrow confines of a tube should be provided with such an appendage. Green, whose most interesting observations were made on the younger stages, wrote as follows: "I discovered some newly-hatched larvæ on the tip of a small tulip tree. They could not have been long out of the egg, little tiny creatures of an orange colour, and in the midst of a spot of froth. I find that the tube is beginning

* *Machærota guttigera*, Westw. † *Adansonia digitata*.

to be formed; the walls of the tube were commencing to rise, enclosing a space of sufficient size to contain the larva in a perpendicular position. At present they are in a horizontal position, and must, by working about, form the foundation of their cells as the froth becomes congealed. One tiny larva is moving about with no froth round it, and with quite a dry skin; the cases have a ringed appearance; this is probably caused by the semicircular motion of the anus of the larva, which is crushed against the interior of the tube sometimes above and sometimes below."

The exact way in which the tubes are formed still remains to



FIG. 5.—THE EMERGENCE OF AN AUSTRALIAN TUBE-DWELLING FROG-HOPPER (*Pectinariophyes pectinaria*). After Hacker, *Memoirs of the Queensland Museum*.

be discovered; it is possible that the non-calcareous part may be secreted from glands similar to those described by Batelli in the common Cuckoo-spit bug. The tube may possibly be produced merely by the drying up of the liquid, or perhaps by the chemical action of the glandular secretion on the anal excretion. However this may be, the fact remains that these tube-dwelling forms are the most remarkable of all the Frog-hoppers, and provide a subject for much interesting research.

As has been shown in this article, we can trace, in the life histories of the Frog-hoppers, a gradual transition from the simplest types, in which the larvæ live in froth masses formed on the aerial shoots of plants, to the more specialized forms in

which the larvæ dwell submerged in liquid contained in calcareous tubes. It would be interesting to determine to what extent this transition has been brought about by attempts on the part of Nature to solve the problem of the evaporation of the bugs' protective froth in hot climates, but our knowledge of the ecology of the group is so fragmentary that this question is at present purely a matter for speculation. The Frog-hopper family (Cercopidæ) has recently been regarded as the most generalized of all the Homopterous bugs, but it cannot be denied that the tube-dwelling members are highly specialized creatures, exhibiting wonderful adaptations to a peculiar mode of existence.

A FER-DE-LANCE'S STRANGE MEAL.

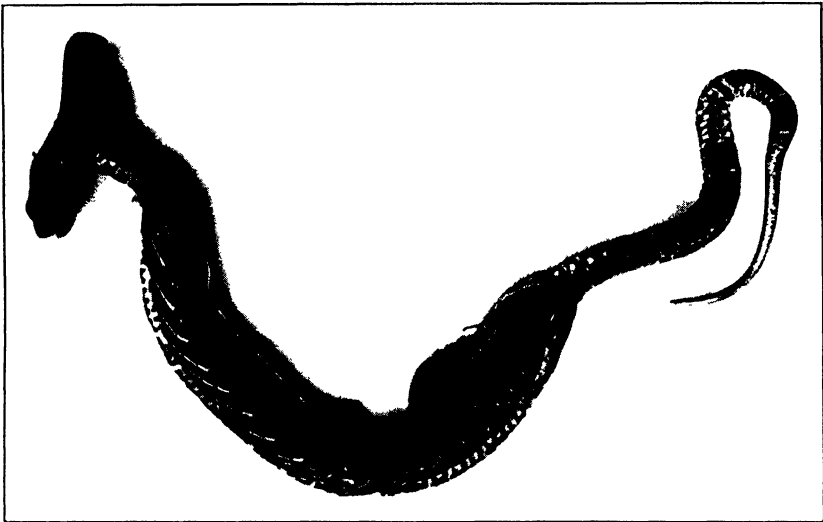
By H. W. PARKER, B.A., Assistant, Department of Zoology.

THE Museum has recently acquired through the generosity of the Scientific and Expeditionary Research Association a rather remarkable Fer-de-lance (*Bothrops atrox*) from the small island of Gorgona off the Pacific coast of Colombia. This snake is a very young one, measuring only 15 inches in length (a large adult would measure 6 feet), but it has succeeded in swallowing a large centipede (*Scolopendra angulata*) $5\frac{1}{2}$ inches long. The accompanying photograph shows the centipede in position in the snake's stomach. It has been swallowed head first and appears to fill about half the total body space of the Fer-de-lance. A meal proportionately so large could probably not be swallowed by any land animal except a snake, for in no other is the stomach so distensible or the jaws specially modified to permit the passage of such a bulky object. The fact that the centipede itself is poisonous is not without interest.

Apart from its size, this meal is of interest because instances of a Fer-de-lance eating an invertebrate are almost unknown. Many snakes, particularly the smaller burrowing forms such as the Blind-Snakes, live exclusively on invertebrates, but the majority of the larger kinds subsist mainly on vertebrates. Among the vipers, to which family the Fer-de-lance belongs, a few aberrant species may feed wholly on invertebrates, as for example the Balkan Viper (*Vipera macrops*), which lives on grasshoppers and similar orthopterous insects; the young of some of the smaller species also may eat them until they attain a sufficient size to enable them to take larger prey. The adult Fer-de-lance, however, normally feeds on small rodents with, perhaps, occasionally a lizard, a frog, or a small bird, and the

young are under no necessity for departing from the habits of their parents; not only is their size at birth sufficient to enable them to master small mice, but they live in a region which produces some of the smallest lizards and frogs known. It appears therefore that, although in captivity many species will deliberately starve themselves to death, a hungry snake in its natural surroundings will not hesitate to make a meal of any animal it can overcome, no matter how indigestible it may appear.

A further point of interest in the young Fer-de-lance is the tail. This organ in the adult is coloured like the rest of the body and functions in a peculiar manner; when an old snake is excited the tail is vibrated rapidly, and, although no trace of a



A FER-DE-LANCE'S STRANGE MEAL.

“rattle” is present on it, the tapping against the surrounding herbage produces a sound reminiscent of that produced by the true Rattlesnakes. The tail of the young, however, is yellow and appears to be used quite differently. The body of the snake, being of a sombre hue, is quite inconspicuous against a background of bare earth or dead leaves, but the moving yellow tail appears to act as a bait which attracts small creatures within reach of the snake's fangs. Whether this is a deliberate piece of “fishing” on the part of the Fer-de-lance may be very much open to doubt, but small frogs have actually been observed to stalk the moving, worm-like tail and, springing upon it, seize it in their mouths. That the centipede was lured to its death in a similar manner is by no means improbable.

THE OBERTHÜR COLLECTION OF BUTTERFLIES AND MOTHS.

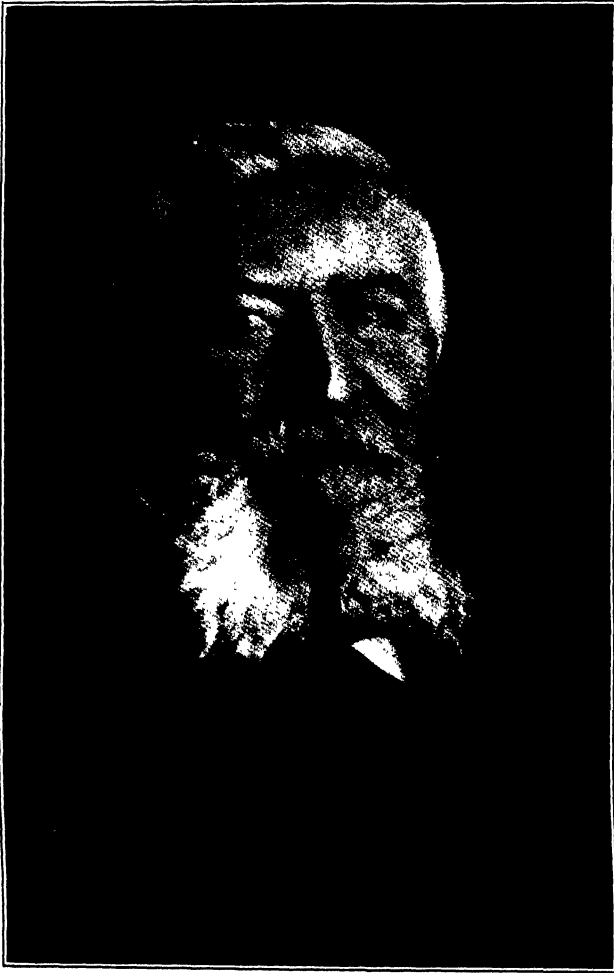
By N. D. RILEY, Assistant Keeper, Department of Entomology.

As the purchase by this Museum of the bulk of the collection of Butterflies and Moths formed by the late Charles Oberthür, of Rennes, has already been mentioned on several occasions in the daily Press, the article printed below can scarcely claim to give the latest news from the Entomological Department. Yet, in view of the size and importance of this acquisition, no apology is here needed for the following brief account of Oberthür's life, of his collection, and of the removal of the latter to South Kensington.

At the time the purchase was effected, certain groups of specimens, unfortunately for the Museum, had already been sold, notably the types of all the North American species and the whole of the Sphingidæ (Hawk-Moths), which were secured by Dr. Wm. Barnes and Mr. Preston Clark respectively, both of these lots going to the United States. The important group of South American Swallow-tail butterflies, and the types of certain other Papilionidæ, the Heliconiinae, the genera *Charaxes*, *Delias*, *Dismorphia*, *Agrias*, and several other smaller lots were bought by Mr. Levick, and, together with the whole of the Zygænidæ, which were acquired by Lord Rothschild, are already in England. The Skippers (Hesperiidæ) were bought by M. René Oberthür, who also secured certain *Parnassius* and a selection of the palæarctic Pieridæ, exclusive of types. The Paris Museum gained the bulk of the Saturniidæ, and the Berlin Museum the whole of the Acraeinæ. Dr. Wehrli bought all the types of the palæarctic Geometridæ, and Dr. Paravicini the entire collection of Microlepidoptera, including the Pyralidæ. A few other small groups were also disposed of, the sections principally affected being those most attractive to collectors or particularly needed by specialists; of all such transactions full details were secured by the Museum. There remained, however, approximately 70 per cent. of the original collection, including a vast amount of almost unworked material, all in excellent condition, still the largest and most valuable private collection ever placed on the market. An opportunity to acquire such a collection is unlikely to occur again, and it is fortunate for the Museum that it was not missed.

Charles Oberthür, born at Rennes in 1845, was the elder son of the founder of the celebrated printing firm which bore

his name, and of which for many years he was chairman. An early taste for entomology was encouraged by his father, who no doubt realized the extent of the relief it was to afford his son in later life from the worries, long hours, and difficulties



CHARLES OBERTHÜR (1845-1924) IN 1910.

of a busy commercial career. It is only a very few years since the immense factory under his control was, as a matter of ordinary routine, working twelve, fourteen, or even sixteen hours a day, and of this toil he bore his full share. The gift of the collection of the famous French entomologist Boisduval—the contemporary of Doubleday, Westwood, Hewitson, and

Bates—and of a special museum building in which to house it, added to the already considerable personal collections of himself and his younger brother René, no doubt set the seal upon Charles Oberthür's earlier ambitions, at the same time inspiring him and affording him the means to gather together the vast collection for which he became justly famed. Money, where entomology was concerned, appeared to be of little account to him, and so he acquired by degrees practically every important collection that came on the market in his own country, and not a few from abroad. In this way he secured the collections formed by Guenée, Ward, Bellier, and Mabille, the last of which includes many of Latreille's types. There also passed into his possession much of the Fassl collection and some part of that formed by H. W. Bates, besides innumerable less well-known collections, and even the Lepidoptera obtained by Ross's second Expedition to the Arctic, which were described by Curtis in 1835 and certainly should never have been allowed to leave England.

A keen interest in the work of the French Roman Catholic Missions, which had penetrated to out-of-the-way places abroad, brought him in return rich collections—particularly from Chinese Tibet, Madagascar, and various African localities—which were, as in many cases they still are, inaccessible to the ordinary collector. Without question, the material received by Charles Oberthür from Sze-chuan, Yunnan, and Chinese Tibet was unrivalled by that of any other museum, whether private or public, and probably surpassed in amount even that obtained by him, chiefly in later years, from Algeria, Morocco, and Tunisia.

Though to all entomologists who came to see his collections Charles Oberthür dispensed the courtly hospitality by which he was distinguished, such visitors, doubtless owing to the relative inaccessibility of Rennes, were few in number; on the other hand, an excellent idea of the treasures in his possession was obtainable from his own publications, in which they were described and figured. Previous to the removal of the Oberthür family from Strasbourg and its establishment at Rennes, it had for generations been intimately concerned in the business of printing. This association in later years bore fruit of great scientific value, for Charles Oberthür was able to be his own patron, printer, and publisher, when, in 1876, he decided to commence giving to the entomological world the long series of priceless volumes known as the *Études d'Entomologie*. In 1902 these were discontinued, since their author considered he

had done his share, and deserved a rest, during which he could devote himself to putting his collections into order. His contributions to the study of the Lepidoptera up to that date might well have justified such a resolve. Yet in 1904 we find him stating in the preface to the first volume of his *Études de Lépidopterologie Comparée* that he can no longer resist the desire to publish again, and to "keep abreast of events in a modest way." The result is to be seen in twenty-three octavo volumes, in which are included many hundred black-and-white plates and text-figures, and six hundred coloured plates, the excellence of which has never been surpassed, seldom even approached, in any other entomological publication. Moreover, the scientific interest of this second series is far greater than that of the original *Études*, since very few groups escaped either his personal attentions or those of the able entomologists whose works he "fathered" in delightful fashion in many of these later volumes. Long and exquisitely illustrated monographs on *Heliconius*, *Agrias*, *Actinote*, and *Castnia* are some few that may be mentioned amongst numbers of others, all equally valuable, and American entomologists will always remember with gratitude the eager response made by Oberthür to their appeal for coloured figures of Boisduval's types of North American Lepidoptera. This proof of the ready and generous help it was ever his delight to give to other entomologists recalls his dictum—" *Pas de bonne figure ; pas de nom valable.*" On the occasion of his only visit to England, he strongly advocated this principle at the International Congress of Entomology at Oxford, in 1912; in fact, he never ceased to urge its adoption, and to apply it in his own case, but it still remains an unattainable ideal to entomologists in circumstances less fortunate than his own. He held aloof from the post-Darwin trend of evolutionary thought, clinging firmly to the theory of the Creation, and on more than one occasion declared that he had found nothing in his study of entomology irreconcilable with his religious beliefs. In his writings there is an irresistible charm, almost reminiscent at times of Fabre; the personal interludes, the brief allusions to scenery and events of the chase, the unfeigned delight at the discovery of some fresh treasure, give glimpses of the soul of a man to whom the form, the shape, and the colour of his subjects were ever the chief attraction. To British entomologists he was but little known personally; but the Entomological Society of London, in recognition of his services to the science to which he was devoted, elected him in 1908 an Honorary Fellow, and thus granted

him a small token of this country's esteem, as well as a distinction which, it is believed, he prized above all others.

Charles Oberthür died at Rennes on the 1st June, 1924. For many months no news was obtainable as to the fate of his collections, which at that time must have contained rather more than a million specimens. Subsequently it was learnt that they would have to be sold for the benefit of his heirs, and that M. Carl Höfer had been appointed to dispose of them. From time to time news was received of sales of certain groups, and it was with satisfaction that it was found these were almost always being acquired by specialists interested in them. At last, towards the end of 1926, an opportunity arose for the Museum to bid, and as a result of a hurried trip to Rennes, memorable to those who took part in it for a variety of reasons quite apart from its consequences to the Museum, the residue of the collection, some 750,000 specimens, was secured.

Bitter recollections of the Channel crossing from Southampton to St. Malo barely a month before, and some misgivings as to the difficulties that might arise at Rennes, hardly lent the departure from Waterloo, on the 14th December last, to collect the first instalment of the Oberthür Lepidoptera, that holiday feeling which it might have acquired had it been possible to postpone the visit until the summer or even the spring; neither did a fear that one might not get home again till after Christmas help to dispel the gloom of a cold, wet, and thoroughly miserable night. However, the sea was kind, and St. Malo was reached comfortably about half-past one on Wednesday afternoon (the 15th), only two hours late. A couple of lift-vans, stowed on deck and most appropriately inscribed "Lep Transport," gave proof that the arrangements so far made were working smoothly. They also attracted much unsought attention when their purpose became known to crew and passengers—attention which later on aroused an unexpected and decidedly unappreciated interest in others, for butterflies were found not to be scheduled in any Customs tariff or scale of freight charges.

The intention had been to load up one van each day at Rennes, but, since the road journey between Rennes and St. Malo would probably take four or five hours each way and the actual loading another six hours, this arrangement was dependent upon two lorries being available all the time; it was also necessary for the loaded van to reach St. Malo before 5 p.m., at which hour the crane drivers cease work.

The greater part of the collection was contained in large,

glass-topped carton-boxes, the boxes themselves being housed in heavy, wooden frames of four different sizes, holding respectively 96, 120, 200, and 250 boxes, the smaller frames resting on top of the larger. In addition, there was one large, built-up oak cabinet, some 9 feet high and 48 feet long, containing 720 drawers. As the maximum height of the lift-vans was only six feet, it was necessary to dismantle the oak cabinet, and also all the sixteen larger frames. The latter, when taken to pieces, proved much more convenient for loading purposes than had been anticipated. Their interior fittings, supporting



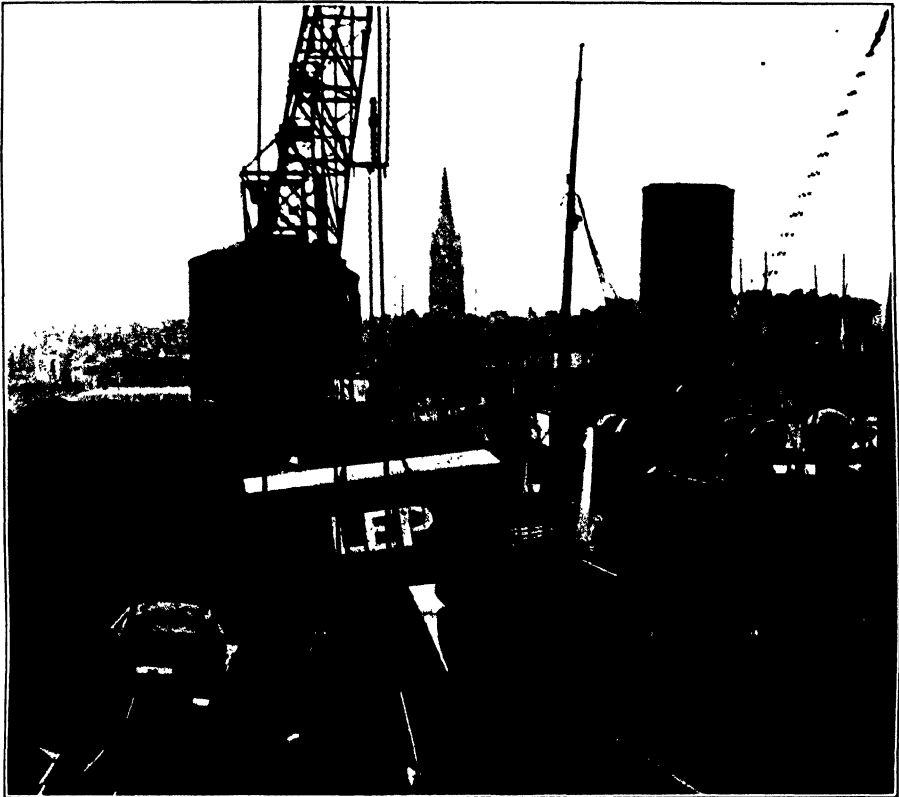
LOADING A LIFT-VAN AT RENNES.

The lorry carrying the lift-van was backed close to a window of the Museum, so that, after the interior fittings had been placed in the van, the carton boxes could be quickly handed through the window and placed in the fittings.

the shelves, were just under six feet in height, and so could conveniently be placed in the vans and refilled with carton-boxes, being first insulated from road-shock by wood-wool packing. Each box was also packed round with wood-wool, and held in position by cardboard strips, and the result was so satisfactory that not a single specimen in all the boxes packed in this manner received any damage whatever. The actual work of dismantling these large frames at first presented such difficulties—it took three carpenters the whole of one day to take the first one to pieces—that it was feared they might have to be rather roughly handled if they were to be brought home.

at all. Fortunately, however, the carpenter who had made them was discovered by the evening of the first day, and after that the work of dismantling went very much more smoothly.

One result of having to dismantle all the fittings was that nearly three thousand boxes had to be packed in crates, a



HOISTING A LIFT-VAN ON TO THE STEAMER AT ST. MALO.

The lorry which conveyed the van from Rennes is visible below on the left. The steamer, which is one of the Southern Railway Company's regular cargo-boats running between Southampton and St. Malo, was specially berthed in the Grand Bassin in order to utilise the crane there after the breakdown of the one at the Southern Railway Company's quay.

laborious process in the carrying out of which great assistance was received from Mmes. Étendard and Le Breton, of the staff of the Oberthür Museum. Contrary to expectations, it was only amongst the boxes so packed that the very few casualties suffered by the collection occurred. These were due to two causes. In one case a certain amount of water, apparently

investigator in the tropical lands in which they are found, and several have tried to solve it without success. The late R. Shelford, author of *A Naturalist in Borneo*, who spent some years in Sarawak, where the insects are common, made great efforts to clear up the problem, and, finding no change to occur from the larval to the adult stage, expressed the opinion that we were confronted with a new phenomenon among beetles, the adult insects of both sexes being exactly like the larvæ.

A successor of Mr. Shelford in the Curatorship of the Sarawak Museum, Mr. E. Mjöberg, resolved to make still greater efforts to probe the mystery. Mr. Mjöberg found several species of "Trilobite" larvæ in abundance upon the mountain slopes of Sarawak, and kept numbers of them in captivity. He at last discovered that some of them became mature females, scarcely differing from the larvæ, and laid eggs; but the males still remained unknown. It was hoped that, as the males of many moths are easily attracted to an imprisoned female, the male of the "Trilobites," so long sought for, might at last be discovered by the same means. Mature females were therefore tethered by long strings in cages of wire netting with a one-inch mesh, in the localities where they were found, but for long with no result. In January, 1924, however, Mr. Mjöberg made a great effort to achieve success, and an expedition was despatched to Mount Penrissen, the highest mountain but one in south Sarawak. In the course of this expedition eighteen cages were established, each with its female "Trilobite," and examined three times a day, but failure again resulted. Still hoping in spite of discouragement, he made a fresh effort in April, and for more than three months the watch was maintained, and crowned at last with success. A male appeared, no giant like the female but a tiny winged insect, seven mm. (about $\frac{1}{4}$ inch) long or one-tenth of the length of the female. During another four weeks a dozen more similar males were secured, and it was therefore established that the great "Trilobites" are the females of a little beetle much smaller than the male of the English Glow-worm and belonging to the family Lycidæ. Mr. Mjöberg (*Psyche*, 1925, vol. 32, p. 119) has named his species *Duliticola paradoxa*.

The Lycidæ are a group of beetles related to the Lampyridæ (Glow-worms and Fireflies), but not like these luminous. They are in general carnivorous, and are found in abundance in nearly every warm climate, being remarkable for their gay and conspicuous colours and patterns, which they display freely in sunny places. Evidently the *Duliticola* group constitutes a

section of the family differing very greatly from the rest. Its members are not found in sunny glades but in dense jungle, where they feed upon the moisture of rotting wood, and, although the females are abundant, the males appear to be far from common. Mr. Mjöberg has found females of six species in Borneo, and others occur in Sumatra, the Philippine Islands, Malay Peninsula, Burma, and elsewhere. Of only one species is the male yet known, and probably few insects have ever been the object of such long and persistent investigation.

BOOK NOTICES.

The Evolution of Man: Essays. By G. ELLIOT SMITH. Second Edition. Pp. xii + 196. (Oxford University Press. London: Humphrey Milford. 12s. 6d.)

OF all the subjects illustrated in the Natural History Museum there is probably none that makes greater appeal to the general public than the ancestry of man. The Museum is particularly rich in fossils that throw light on this vexed question, and the exhibited series near the entrance to the Geological Galleries has been completed by reproductions of other famous specimens. There the visitor may study the *Eoanthropus* or Dawn Man of Piltdown, the remarkable beetle-browed skull of Rhodesian man (both among the greatest treasures of the Museum), the *Pithecanthropus* or Ape Man of Java, the massive jaw of Heidelberg man, the calvarium from Neanderthal, and the many skulls of the same race or species found at Gibraltar, at Spy in Belgium, at La Chapelle-aux-Saints in south-west France, and quite recently in a cave near the Sea of Galilee. Then there are early skulls of *Homo sapiens* himself, or possibly some primitive or divergent race, such as Boskop man from the Transvaal, the Talgai skull of Queensland, the Galley Hill skull lent by Dr. Frank Corner, and the interesting fragment from the City of London, known to us as Our Lady of Lloyds. There also are the various apes that show one or other character, leading in the direction of man. Such are the Miocene *Dryopithecus* and *Sivapithecus* to which Dr. Pilgrim has recently drawn attention, as illustrated by a special temporary exhibit, and *Australopithecus* found in 1924 at Taungs in Bechuanaland.

"A Guide to the Fossil Remains of Man" is published by the Trustees of the British Museum, but those who wish to gain a deeper and clearer insight into the meaning and relations of these important fossils cannot do better than read this collection of essays by Prof. Elliot Smith, now available in a revised edition with all the recent discoveries incorporated. Especially is this book to be recommended to those who would study the history of man's most distinctive organ, his brain. On this subject Prof. Elliot Smith is our highest authority, so that he approaches the evolution of man at a somewhat different angle from that usual with those who deal mainly in bones.

Accepting a very common view that the far-distant ancestors of man were arboreal, the author shows how this made the sense of sight more important than that of smell, which hitherto had been the governing sense of the earlier

land-vertebrates. This basic sense was brought into connection with the other senses by a part of the cortical area of the brain, which spread like a cloak over the olfactory lobes in front and the cerebellum behind, and is called by Prof. Elliot Smith the neopallium. This structure, characteristic of mammals, welded together the senses of sight, hearing, and touch and became an organ of associative memory. Smell still, to a large extent, started the reaction to food, but sight directed it, brought hearing into connection, and guided the movements of the fore-limbs. The diminution of smell and the shortening of the muzzle permitted the development of stereoscopic vision with consequent more accurate control of the hands.

It is not the more perfect hand that raises man above other mammals, for the hand actually retains the primitive plan of structure; it is the foot that shows specialization. No! it is the brain's power of controlling the hand. And here Prof. Elliot Smith sees a virtue in that asymmetry of the brain which gave preference to one hand—normally the right—and brought it to higher perfection. So, too, it is not man's erect attitude that brings him nearer to heaven, as they used to say, for many apes started on that line and might have got there had they not lacked that organization of brain which governs the rhythmic balance and movement of a highly-trained body. In many of his physical characters man is an ape that, by comparison with the anthropoids, is not grown up—"a simian Peter Pan." But in his brain man is far beyond them all. It was his intelligence that enabled him to emancipate himself from forest conditions, to become a wanderer over the face of the earth, to adapt himself by artificial means—tools, clothing, fire—to varied and often inhospitable surroundings, and above all to communicate with his fellows by speech.

We of this Museum welcome particularly the interesting accounts of the brains of Piltdown and Rhodesian man. These are based on plaster casts taken from the inside of the skulls, and gradually built up. A further study of the Rhodesian brain by Prof. Elliot Smith will appear in a detailed account of all the human and associated remains from Broken Hill now in active preparation. Meanwhile we note that the author regards the Rhodesian brain as more primitive than that of Neanderthal man, and this, in view of the disputed relations of the two types of skull, is a singularly important piece of evidence.

Prof. Elliot Smith's vigorous style is familiar to many readers, but we may give due praise to the no less vigorous and accurate drawings by Mr. T. L. Poulton, which admirably illustrate the text.

British Ants: their Life History and Classification. By H. ST. J. K. DONISTHORPE. Second Edition. Pp. ix + 436, with 18 plates and 93 figures. (London: George Routledge & Son, Ltd. 25s.)

THE author is to be congratulated on the appearance of a second edition of this full and exhaustive account of British Ants—native and introduced—and the extraordinarily varied assembly of other organisms, pensioners, parasites and guests, amongst which the drama of ant life is played. Since 1916, when Mr. Donisthorpe's work first saw light, considerable additions have been made to the general literature of Myrmecology, and the results of these scattered researches when bearing on our fauna have now been made accessible to British readers. Great advances have been made in our knowledge of Myrmecophiles, so much so indeed, that Mr. Donisthorpe now promises us a book devoted exclusively to this subject. Two species (*Myrmica schenki* Emery, and *Acanthomyops brunneus* Latr.) and two varieties are added to the British List—no

inconsiderable achievement in view of the small number of species occurring in these islands. The full list now contains 35 species and 12 varieties.

The general plan of the work and the nomenclature (apart from minor alterations) remain as in 1916. Its merits and defects are therefore in the main unaltered. As to the former, one cannot sufficiently admire the energy, patience and enthusiasm which Mr. Donisthorpe has shown for over thirty years in the study of his favourite group. He has collected widely, and inspired others to do the same; he has kept every species he could under close observation in cunningly contrived nests, and thereby added much to our knowledge of the life history of ants. He has also collated every reference, and his list of authorities is formidable, over 200 authors being quoted. But the method of presenting the resulting mass of material leaves much to be desired. Under each species we have a series of notes or quotations set down side by side with little attempt at generalizing, and much irrelevant detail is admitted. We are not even provided with a few simple headings by the use of which the data under each species might be compared. We have noted this objection first because the treatment of the species occupies the bulk of the volume. The introductory chapters (pp. 1-65) offer an extremely good and condensed account of ant structure, life history and distribution, while very full directions on collecting, care in captivity, preserving and mounting are laid down.

The purely systematic part of the work is of somewhat uneven value. The diagnoses of the families and genera are adequate, and the synonymy is admirably presented, but the specific tables are vitiated in places by an evident determination to make each division an exact antithesis. Thus in *Myrmica ruginodes* Nyl. the "epinotal spines are longer than their basal width (distance apart ?), transversely striate between," while in *levinodis* Nyl. "the spines are not longer . . . smooth between," but Mr. Donisthorpe also admits a variety *ruginodo-levinodis* Forel, to include *all* intermediate forms. Without expressing any opinion as to the status of the ants under discussion (a matter in which different views are held by systematists), it must be clear that as regards definition we are no further on. Into such matters, however, we cannot here enter fully. Although several of the plates poorly serve their purpose, the text-figures are numerous and useful; the general get-up of the book excellent, and its size convenient. It will long provide the indispensable ground-work for students of our British ants.

STAFF NEWS.

MR. ANTONY GEPP, who retired from the service of the Trustees on May 9 last, joined the Staff of the Department of Botany in January 1886. A new post had been created in the Cryptogamic Section, the work of which Mr. Gepp was to share with Mr. George Murray, under the Keepership of Mr. William Carruthers. Mr. Gepp's charge was the Mosses and Liverworts, his colleague being responsible for the Seaweeds and Fungi. A few years later Murray started his *Phycological Memoirs*, and among the voluntary workers for this magazine was Miss Ethel Barton, who soon acquired, in addition to considerable skill in technique, a good working knowledge of the seaweeds. After her marriage to Mr. Gepp she continued her work on the seaweeds with her husband's help, and several valuable joint memoirs were the result. Mrs. Gepp's breakdown in health, which necessitated the removal of the family to Torquay, was a

serious loss to Algology, but Mr. Gepp retained his interest in the group, for the curating of which he has since been responsible. On Mr. Carruthers' retirement Mr. Gepp had also taken charge of the Fern Herbarium; and for the greater part of his period of service students of Ferns, Mosses, and Seaweeds have looked to him for help, and the news of his retirement will bring a feeling of serious loss. Fortunately Mr. Gepp wishes to continue his association with the Museum, and his friends will find him there busy with the Ferns. Mr. Gepp is an Essex man. His father was for many years rector of High Easter near Dunmow, and he was educated at Felsted School. From there he went, in 1881, to St. John's College, Cambridge, and worked for the Natural Sciences Tripos, specialising in Botany under Dr. Sidney Vines and the late Francis Darwin. He took his B.A. in 1885, and a few months later entered the Museum by open competition. I made Gepp's acquaintance (he was two years my senior) in the chemical laboratory at St. John's, and have had the privilege of close association with him as friend and colleague for nearly forty years. Happily this is not an obituary notice, and a certain restraint is therefore indicated. But some slight acknowledgment is owed to a service, extending over more than forty-one years, of single-eyed devotion to duty and unselfish consideration of the interests of his colleagues and other workers in the Department.—A. B. R.

* * * * *

By the death of James Joseph Parkes, General Foreman, on June 22, the Trustees have lost the services of a valued and capable servant. Mr. Parkes had held the office of General Foreman since April 22, 1901. He was born on July 27, 1857, and was therefore within a few weeks of his seventieth birthday.

* * * * *

The Trustees have made the following appointments to Assistantships, to fill the vacancies arising from recent retirements from the Staff :—

Miss Anna Birchall Hastings and Miss Susan Finnegan in the Department of Zoology; Miss Daphne Aubertin in the Department of Entomology; Mr. Frederick Allan Bannister in the Department of Mineralogy; and Mr. James Edgar Dandy in the Department of Botany.

Miss Hastings was educated at Roedean School and at Newnham College, Cambridge, where she obtained a first class in Part I and a second class in Part II of the Natural Sciences Tripos in 1924 and 1925 respectively.

Miss Finnegan was educated at Victoria College and at Queen's University, Belfast, and graduated B.Sc. with first class honours in 1925.

Miss Aubertin was educated at the Ladies' College, Cheltenham, and Bedford College, London. She graduated B.Sc. with first class honours in the University of London in 1925 and obtained the M.Sc. degree in 1926.

Mr. Bannister, who was educated at Clare College, Cambridge, gained a first class in both parts of the Natural Sciences Tripos in 1922 and 1923 respectively.

Mr. Dandy was educated at the Grammar School, Preston, and Downing College, Cambridge. He gained a first class in Part I and second class in Part II of the Natural Sciences Tripos in 1924 and 1925 respectively.

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AFRICAN ELEPHANT SCENE.

By J. G. DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

A GROUP of South African elephants—male, female, and young—has recently been placed in a bay of the Central Hall



Photograph by

General Electric Company, Ltd.

AFRICAN ELEPHANT SCENE.

of the Museum in a scenic representation of their original surroundings.

The South African elephant (*Elephas africanus capensis*) was once widely distributed over a great part of South Africa, and

until quite recently was to be found in considerable numbers in certain areas in Cape Colony. Elephants have been protected in Cape Colony for a number of years, but, owing to the damage done by them to cultivation, it was unfortunately deemed necessary a few years ago to destroy the Addo Bush herd. The only elephants that now remain in South Africa are a few isolated animals in the Knysna and Zitzikama forests.

At the time when the Addo Bush elephants were destroyed the Government of South Africa presented the Museum with the skins and skulls of an immature female and a young male from the Addo Bush, and of a sub-adult male from the Knysna forest. The specimens were mounted in the Rowland Ward studios and were for some time exhibited in the Central Hall; they are illustrated on Card B 40 of the Picture Postcard Series.

The possibility of exhibiting these animals in their natural surroundings was considered and a scale-model, prepared by the writer, was laid before the Trustees and approved by them. Inasmuch as the Knysna forest possesses more picturesque scenery than the Addo Bush, the former was selected as the setting for the group, and to enhance the naturalness of the scene the Government of the Union of South Africa was asked to supply the trees and vegetation required from the actual forest. The request was readily acceded to, and the Government's forestry officials took the greatest pains to ensure the safe transit of the material. The large tree was mounted on special sledges and a path cut through the forest for its passage, and owing to the difficulty of loading the boxes on to the railway trucks the bulk of them was sent to the steamer at Knysna Harbour by ox-wagon. The Thesen Steamship Company which conveyed the specimens from Knysna Harbour to Cape Town, and the Union Castle Steamship Company which brought them on to London, both made no charge for their services.

The trunk of the fine Yellow-wood (*Podocarpus falcatus*), which weighs over a ton, is to be seen to the right hand at the back of the scene, and the thinner trunk standing near the front on the left-hand side is an Iron-wood (*Olea laurifolia*). In addition there are a number of ferns (*Aspidium capense*), a Tree-fern (*Hemitelia capensis*), a White Bird of Paradise Flower (*Strelitzia augusta*), and a quantity of tangles (*Helichrysum*). The scenery has been painted by the writer with the assistance of Mrs. Dollman. Since the bay in which the scene is placed would have been insufficiently illuminated by light from the Central Hall and artificial illumination was called for, it was decided to add to the verisimilitude of the exhibit by imitating

the natural lighting in the forest. The lighting effects, which have been designed by Dr. G. F. Herbert Smith, have been arranged so as to give the gradation from the soft light of the rising moon to the full blaze of sunlight.

THE UPNOR ELEPHANT.

By F. A. BATHER, M.A., D.Sc., F.R.S., Keeper of Geology.

At last the great Elephant from Upnor, or so much of him as could be made presentable, is mounted and on public exhibition, and during the last few weeks the public has not been slow to marvel at the mass of the monster skeleton. How many of them realize the knowledge, the technical skill, the labour of head and hand, represented by this one exhibit? I am not sure that I realize it myself, but it is more than I would venture to reduce to pounds, shillings, and pence, for fear of rousing the anger of those who always look to Science for an immediate return.

To some she is the goddess great,
To some the milch-cow of the field,
Their only care to calculate
How much butter she will yield.

But let me set down the bare facts and leave the reader to make the calculation.

Three or four years before the war a party of Royal Engineers from Chatham was driving a practice trench through some sandy loam that had filled an old river bed near Upnor on the banks of the Medway in Kent. The trench was cut unwittingly through the great skeleton and destroyed a large number of bones and a tusk. Unfortunately the attention of the British Museum was not drawn to the occurrence till 1913, when a local resident, Mr. Sid Turner, picked up some pieces of bone and sent them for identification. One of these was recognized as a carpal or wrist-bone of an unusually large elephant. A reconnaissance confirmed the presence of other bones, but owing to the bad weather, the onset of the war, and other causes, it was not till the summer of 1915 that arrangements could be made to continue the recovery of the skeleton.

The task of extracting and preserving the bones was no simple matter. It was carried out, under the supervision of the late Dr. C. W. Andrews, F.R.S., by Mr. L. E. Parsons, who lived close at hand for nearly three months. The difficulty of the work was enhanced by the dampness of the situation and the

fragility of the bones, which lay so near the surface that they had been riddled by roots and worms. In removing them from the tough clay in which they were embedded it was necessary first to expose as much as possible of the upper surface of each bone, then to cover this with strips of canvas dipped in plaster of Paris. When this had set, the bone was turned over, cleaned of the clay so far as seemed safe, and then treated similarly on the other side. Thus it was enclosed in a hard case which held the fragments together during their transport to the Museum. There the wrappings had to be removed with extreme care, and the bones dried slowly and then soaked in size. In some cases the rotten inside was taken out and an iron bar inserted and set in plaster. The bone was then coated with shellac.

This was not all. Many of the bones had lost large pieces, and these had to be supplied in plaster, carefully modelled after the corresponding bone of the other side when that was preserved, or after the same bone in another elephant but on a proportionate scale. Some of the foot-bones were entirely missing and had to be reconstructed in the same way. Thus, at last, Mr. Parsons, working under the direction of Dr. C. W. Andrews, F.R.S., had reconditioned the two hind-limbs, with the limb-girdle of the pelvis, the left fore-limb, most of the vertebræ, three grinders and a tusk. The skull was seen by Dr. Andrews and Mr. Parsons, but owing to the spongy nature of the bone, characteristic of the elephant's lofty forehead, the worms and the roots had reduced the whole to little more than a crumbling simulacrum which no treatment could solidify.

On the conclusion of peace the task of putting together and repairing the fragments was continued, and their scientific study was undertaken by Dr. Andrews. Then should have come the task of mounting the bones into a skeleton, or so much of one as they permitted. But the iron-work needed would cost more than the funds at the disposal of the Keeper of Geology. Fortunately a good friend of the Museum, Dr. W. Rushton Parker, offered to defray that expense. Then a severe blow fell on us in the death of our colleague Dr. Andrews, who had devoted so much attention to the Proboscidea. At the very same time the distinguished authority on fossil vertebrata, Sir Arthur Smith Woodward, resigned the Keepership. Mr. Forster Cooper, Director of the Museum of Zoology at Cambridge, came to our rescue and took over the study of the bones.

But, before we could embark on the iron-work, it was necessary to erect the skeleton in temporary fashion on wooden supports. It was some months before carpenters were at liberty,

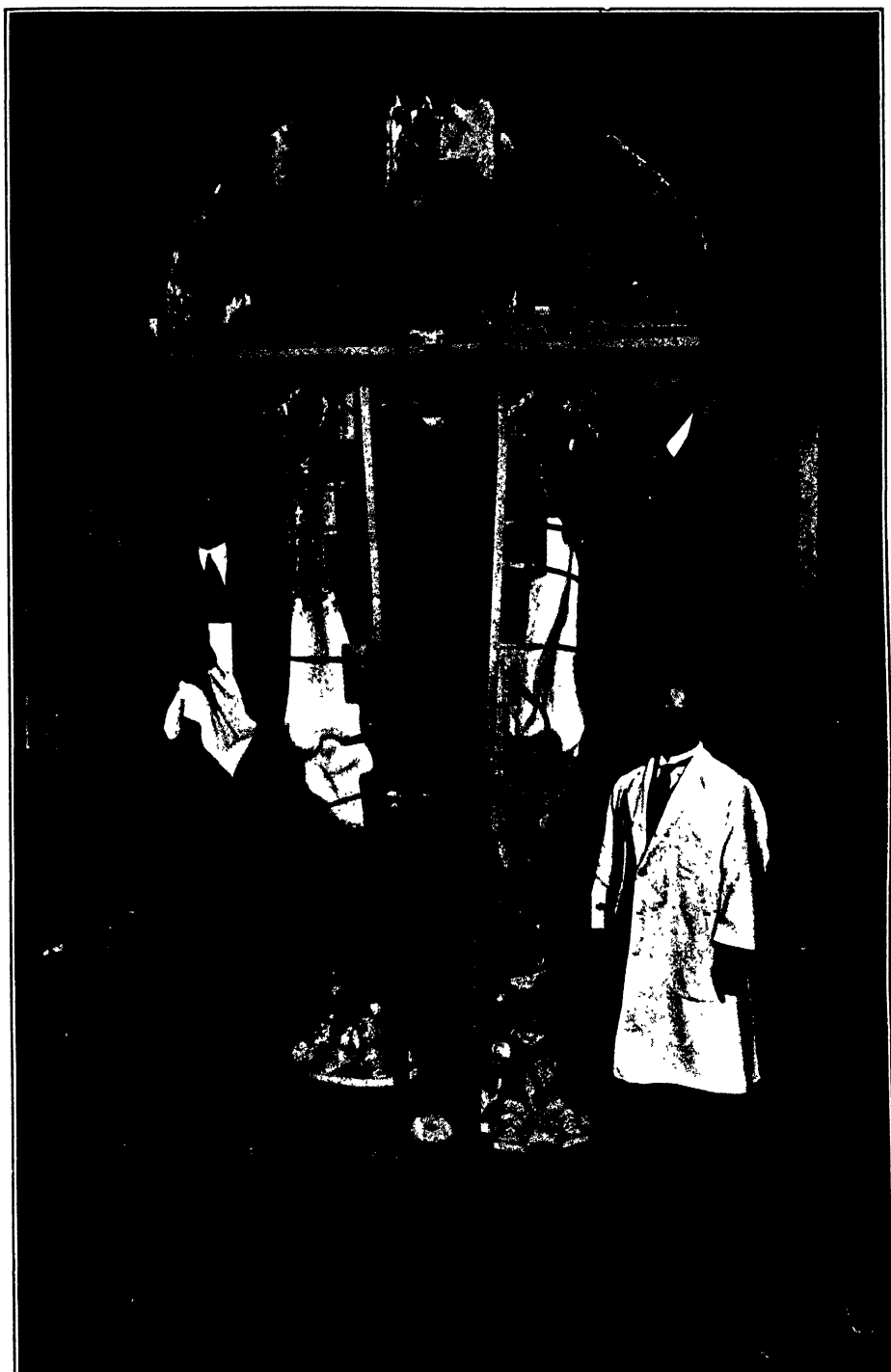


FIG. 1.—SKELETON ON WOODEN STAGING IN BASEMENT.

but at last we set to work in earnest, and the result of three months' labour is shown in the photograph (Fig. 1). Every single bone has to be carefully adjusted and viewed from all positions so as to give a natural effect. Constant alteration is required. We now see the left leg advanced and set firmly down, while the right leg begins to rise on the toes so as to follow it. Above is the great pelvic basin or limb-girdle, most carefully supported by a wooden cradle, so rigidly constructed as to relieve the bones from all possible strain as the mass is swung up to the roof and lowered into position.

Then followed the making of the iron-work, and here fresh difficulties arose. We had lost the smith who had become accustomed to our work. It was not feasible to establish a forge inside the Museum, so every piece of iron, while being bent and rebent to satisfy the conceptions of the experts, had to be carried backwards and forwards between the skeleton and a small forge in the grounds. At last those exacting gentlemen agreed, and then came the business of dismounting every bone, carrying each part upstairs, and remounting it on the main iron standards.

Some of the large skeletons in the Gallery of Fossil Mammals had been shifted and a solid base of polished mahogany laid down to receive the standards. These had to be fitted with the utmost exactitude (Fig. 2) or the whole work would have been thrown out. A scaffold was built over the whole, and the mighty pelvis in its cradle was swung into its final position (Fig. 4). Other stages of the re-erection, which occupied some months, are shown in our photographs (Figs. 3, 5). Then there was the putting up of the guard-rail, the writing, printing, and framing of the labels, a final polish of the base and all was ready for—no, not for the public, but for the photographers and the Press.

The photographing of the skeleton in a scientific manner was really a serious business, partly because one could not get to the proper distance, partly because large cases and exhibits were in the way, and partly because of the cross-lighting and absence of blinds. Powerful electric lights and temporary screens enabled us to modify the last difficulty. Then the barriers were removed, and on July 23, after inspection by the Trustees, this work that had occupied a large part of the preceding twelve years was open to public view (Fig. 6).

The skeleton as mounted consists of the hind-limbs supporting their great pelvic girdle, the backbone complete except for two vertebræ, and the left fore-limb. The bones of the limbs, as already explained, are not quite complete, but have been



FIG. 2.—SETTING OUT BONES ON TRANSFER FROM THE TEMPORARY BOARDS TO THE FINISHED BASE.



FIG. 3.—PUTTING UP THE IRON SUPPORT FOR THE VERTEBRÆ OF THE BACKBONE.



FIG. 4.—GETTING THE PELVIS INTO POSITION.



FIG. 5.—PLUMBING THE STANDARD.

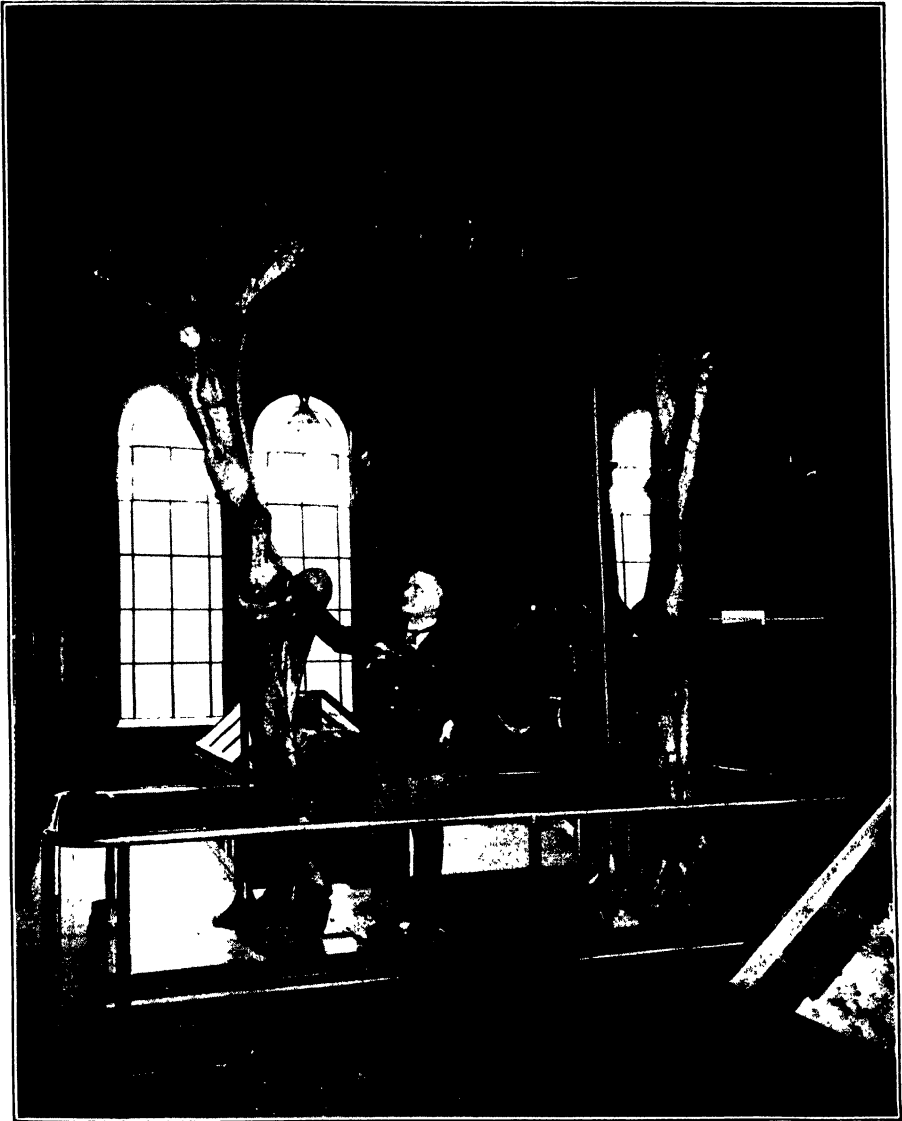
partly restored in plaster. In most cases this was done without fear of error by modelling a reversed copy of the bone preserved in the opposite limb. Thus the radius of the left fore-leg is entirely plaster, but is based on the right radius, which fortunately was saved. This right radius, with some bones of the right foot, one of the tusks, too shattered for restoration, three grinding teeth, and some associated bones of pig, deer, and hyæna, are shown in an adjacent case.

The species to which this elephant belongs, *Elephas antiquus* of Falconer, sometimes called the Straight-tusked Elephant to distinguish it from the Curly-tusked Mammoth, is nearly always represented by bones that indicate individuals of large size. No complete skeleton has ever been obtained, and ours, incomplete though it be, is far nearer perfection than any other yet known. The highest point of the backbone is 12 ft. 7 in. from the ground, and the top of the shoulder-blade reaches 12 ft. 1½ in. The pelvis has an actual width of six ft. less ⅛ in., but, since its edges have been much broken and eaten away, it may well have exceeded this by 6 in., or 20 in. more than the width of the pelvis of the largest mammoth. The safest comparison is based on the well-preserved upper arm-bone (humerus), which has a length of 4 ft. 1 in., as compared with 3 ft. 1 in. in the biggest Indian Elephant (*E. maximus*) in the Museum. Visualizing the animal in the flesh, one must add several inches of muscle and skin to the height, which may safely be estimated at a full 13 ft.

My colleague, Mr. J. G. Dollman, tells me that the Indian Elephant averages 9 ft. at the shoulder in males, the record height being 10 ft. 6 in. The African Elephant (the largest land-mammal now living) has a record of 11 ft. 8½ in. Two have been recorded as 11 ft. 6 in.; but individuals of 11 ft. are now very scarce. Dr. Julian Huxley, who has been studying the comparative weights of animals, estimates the weight of our elephant when alive as from 10 to 12 tons. This weight perhaps accounts for the relatively short distance between the fore and hind limbs.

The size of this skeleton is by no means its most interesting feature. For the first time we can form some idea of the creature as a whole. A full description, drawn up in part by the late Dr. C. W. Andrews and completed by Mr. C. Forster Cooper, will soon be published by the Trustees, and in it attention will be drawn to various features observed in the specimen. Here one may point out the upstanding spines of the vertebræ, which do not slope backwards as in other elephants, the relatively

small size of the grinding teeth (exhibited in an adjacent case), the stoutness of the limb-bones in connection with the vast



Photograph by

"The Times."

FIG. 6.—SKELETON MOUNTED IN PUBLIC GALLERY.

bulk of the animal, and the alternation or interlocking of the small bones of the foot, especially in the hind-feet, so as to distribute the enormous weight.

The position in which these remains were found indicates that the animal was living in this country during a somewhat warm period which immediately preceded the Great Ice Age. Though no actual implements were found associated with the bones, there is no doubt that man was living in the country at the same time. Other remains of *Elephas antiquus* have been found throughout England and Wales, as far north as Yorkshire, in various deposits beginning with the Norwich Crag and the Cromer Forest Bed. The species ranged through Europe and Asia, and apparently into northern Africa; but there seem to have been various races, which cannot be properly distinguished in the absence of complete skeletons. To trace the evolution of the Proboscidea and the changes that took place as these great beasts roamed throughout the centuries from continent to continent is a fascinating problem. From its solution we might learn much of the laws that govern the evolution of life. But it is a problem that presents peculiar difficulties due to the scattered and incomplete nature of the evidence. The importance of our skeleton, that which justifies the expenditure of time and labour upon it, is that it has so much more nearly approached completeness than any other specimen of the species.

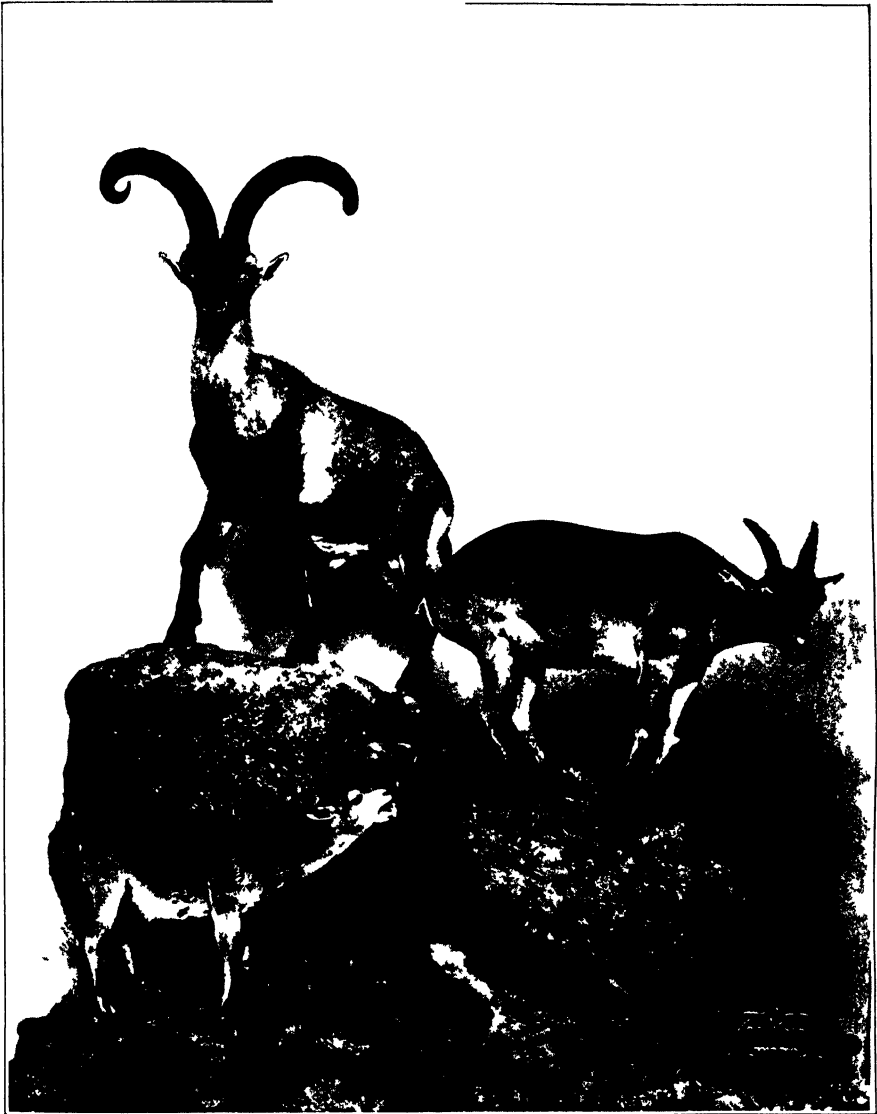
GROUP OF SPANISH IBEX: GIFT OF THE KING OF SPAIN.

By J. G. DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

THE group of Spanish Ibex, recently presented by H.M. the King of Spain, is one of the most important additions received during the present year. The group consists of a male, female, and young of the Sierra de Gredos Ibex, which was described in the *Proceedings of the Zoological Society* for 1911 by Prof. Angel Cabrera, and named by him *Capra pyrenaica victoriae*, in honour of H.M. the Queen of Spain.

This race of Ibex was hitherto unrepresented in the Museum collection, which contained only a few specimens of the nearly allied *Capra pyrenaica hispanica* from Sierra Nevada. The Sierra de Gredos Ibex was at one time nearly exterminated, and its present flourishing condition is chiefly due to King Alfonso, who has taken all the necessary steps to ensure its preservation.

The specimens, excluding the female, were shot by His Majesty, and the group has been most artistically mounted by Señor Luis Benedito, the well-known Spanish sculptor and taxidermist. The group was unveiled by the King of Spain in the presence of King George on July 7, 1927.



GROUP OF SPANISH IBEX

A CRYSTAL OF AQUAMARINE.

By L. J. SPENCER, M A , Sc D , F R S , Deputy Keeper,
Department of Mineralogy.

A REMARKABLE crystal of aquamarine, recently acquired for the mineral collection, affords perhaps the most striking and

impressive example of a single crystal approaching perfection and of large size in the whole of the collection. Large crystals usually display some irregularities of development or growth, and in fact they may often be seen to be built up of a number



FIG. 1.—CRYSTAL OF AQUAMARINE FROM BRAZIL ($\frac{3}{4}$ NATURAL SIZE).

of smaller crystals in approximately parallel positions. The more perfect crystals are, as a rule, quite small in size, and they need the aid of a magnifying lens for their study; but here we have an almost perfect crystal that will be readily visible in the exhibition cases, and which, moreover, is a beautiful natural

object. It is clear and transparent and of a rich bluish-green colour. Being of gem quality, it is of some intrinsic value; and, if it had not fortunately been secured for the collection, it would no doubt have been sacrificed to the lapidary for cutting up into a large number of small faceted gems, and so lost its individuality as a crystal.

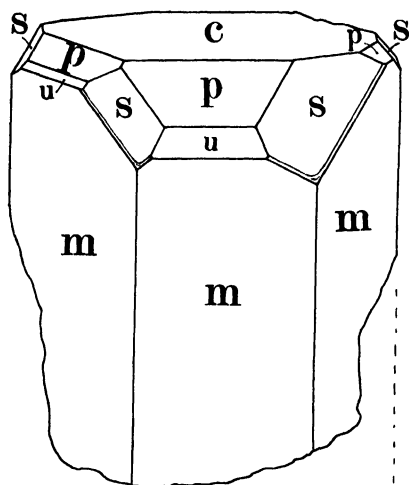


FIG. 2.—OUTLINE SKETCH AND PLAN SHOWING ACTUAL DEVELOPMENT OF FACES.

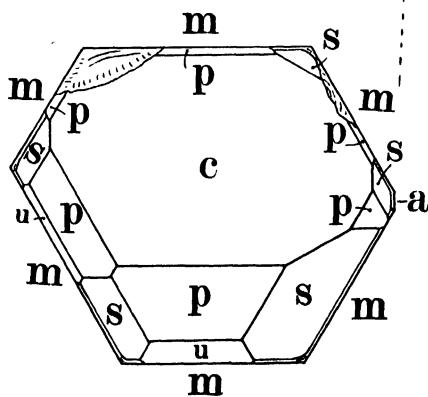


FIG. 2.

FIG. 3.—PLAN SHOWING IDEAL DEVELOPMENT OF FACES.

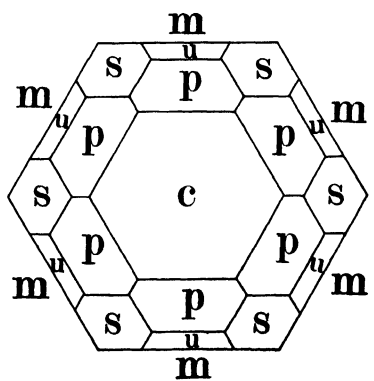


FIG. 3.

Aquamarine, we may here explain, is a gem-variety of the mineral-species beryl, a silicate of the chemical elements aluminium and beryllium. This mineral is the principal source of the light metal beryllium, which is now coming into demand for the preparation of alloys used in the construction of aeroplanes and airships. Alloys of beryllium and aluminium are lighter,

harder, and stronger than aluminium itself. Beryl when chemically pure is colourless, but in this form it is quite a rarity. Usually the material is coloured (or dyed) by traces of various impurities. It may be rich grass-green as in "emerald," sea-green as in "aquamarine," rose-pink as in "morganite," or golden-yellow as in "heliodor." In these gem-varieties the material must be clear and transparent in addition to displaying a good colour. Usually, however, the mineral is opaque and dull in colour. There are already in the collection far larger rough crystals of "common beryl," and crystals of this kind, weighing one or two tons, have been found in America. A beryl crystal, measuring about a cubic yard, is shown in the Museum of Natural History at Boston.

Beryl as distinct from many other minerals is marked by the strong individuality of its crystals, which almost always grow singly; groups of crystals and crystalline aggregates are exceptional. The typical form of the crystals is a hexagonal prism, usually terminated at one end by a single plane at right angles to the prism, while at the opposite end the crystals are attached to the rock on which they grew. The majority of the beryl specimens shown in the collection are seen to be single crystals broken at one end, and this is also the case with the crystal now described. On this crystal, shown in the photograph (Fig. 1), in addition to the six faces of the hexagonal prism and the one basal plane (lettered *m* and *c* respectively in the outline sketch, Fig. 2), there are a number of pyramid faces; also a single narrow face (*a* in the plan, Fig. 2) of a second hexagonal prism set at 30° to the first, but represented by only one face instead of six. The six faces of the hexagonal pyramid *p* although very different in size and shape are equivalent faces, and they slope away from the base at the same angle. A second hexagonal pyramid *s* is represented by five faces instead of six, while a third hexagonal pyramid *u* has only two faces showing. The narrow bevellings on the edges between the faces *m* and *s* belong to a dihexagonal (twelve-sided) pyramid. The apparent lack of hexagonal symmetry shown in the plan in Fig. 2 is merely due to accidents of growth, more material having been supplied to one side of the crystal than to the other during the later stages of growth. By planing down the smaller faces parallel to themselves the ideal form shown in plan in Fig. 3 would result. It will be noticed that the edges and directions are the same in the two plans (Figs. 2 and 3), except that in Fig. 3 intersections of *s* and *c* are omitted.

When the crystal had completed its growth (having no doubt

been deposited from hot aqueous solutions in a rock-cavity in pegmatite) it commenced to be re-dissolved. This corrosion of the crystal is beautifully shown by the etch-figures or minute pits on all the faces. As may be seen with a lens, the shapes of these etch-figures conform with the true symmetry of the face on which they are present. The faces, or rather areas, marked *u* show corrosion of a peculiar type: they are concave and consist of a cylindrical series of complex facets rather than a single face. The narrow rounded bevellings of the dihexagonal pyramid also seem to be the result of corrosion. This period of corrosion evidently followed a period of disturbance in the enclosing rocks; for the broken corner of the crystal (accounting for the missing *s* face) shows etching on the conchoidal fracture.

Another point of interest shown by this crystal is presented by the internal cavities (negative crystals) marking different stages in the growth of the crystal. Some of the cavities are filled with yellowish clay, which has the effect of imparting a yellowish-green cast to the crystal. The clear portions are, however, bluish-green, and the phenomenon of dichroism is well shown—the crystal being a deeper shade of colour when viewed through the basal plane than when viewed through the prism faces.

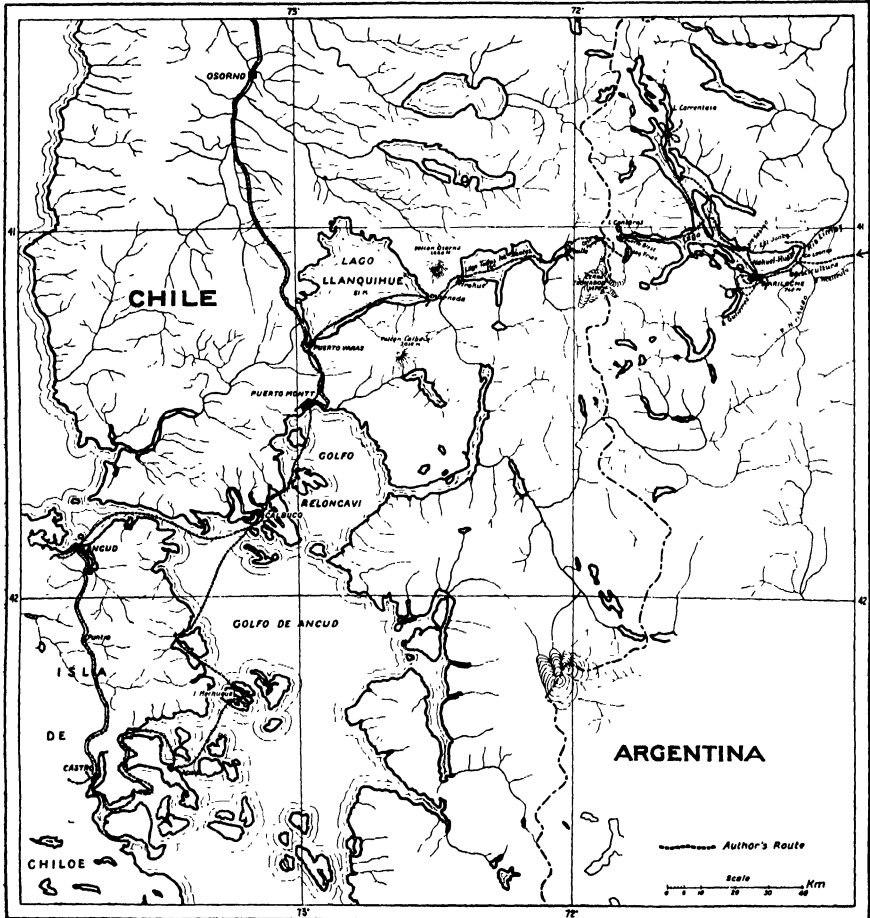
This crystal measures 13 centimetres in height with a diameter of 10–12 cm. and weighs 2505 grams (12,525 carats). It is stated to be from “Bingara,” Minas Geraes, Brazil. A much larger crystal, etched and showing only the faces *mc*, but evidently of the same type of gem material, was found in 1910 in a pegmatite vein at Marambaia near Arassuahy in Minas Geraes. It measured $48\frac{1}{2}$ cm. in height and 40–42 cm. in diameter, weighed $110\frac{1}{2}$ kilograms (243 lb.), and fetched a high price for cutting.

INSECT COLLECTING IN THE SOUTHERN ANDES.

By F. W. EDWARDS, M.A., Assistant, Department of Entomology.

IT is now almost a century since Darwin set out in the *Beagle* to explore the almost unknown wilds of southern South America. With the lapse of time much has changed; large areas have come under cultivation, marauding Indians have disappeared, and considerable advances have been made in our knowledge of the natural history of the region: but much remains the same; the forest and the desert hold their own, and

in the Southern Andes there are thousands of square miles of untrodden forest and many an unclimbed peak. The plants, the few large mammals, and the birds of these parts have been well studied, especially by Swedish scientists, but among the smaller forms of life a great deal still remains for investigation. Insects in particular have been neglected; for, while collectors



MAP SHOWING AUTHOR'S ROUTE.

have ransacked most parts of the tropics and filled our museums with their captures, scarcely any collections of insects have been made in southern South America since Darwin's time, and many even of the specimens obtained by him have remained undescribed to this day.

A glance at a physical map of South America will reveal some very striking features. In the southern portion of the

continent the narrow Pacific strip and the Andine chain have a very heavy rainfall, while the Atlantic plains have hardly any. As we proceed northwards the rainfall on the western side decreases, until on reaching central Chile we find a semi-arid climate, and in northern Chile and Peru the coastal regions are barren deserts. On the eastern side we find the opposite, the Patagonian deserts giving place first to the grassy pampas with moderate rainfall, and then to the luxuriant damp forest of north-eastern Argentina and Brazil. The effect of these conditions, which have probably persisted for a long time, is that in the south-west, from Tierra del Fuego to about the latitude of Valdivia or Concepcion, there exists an area of forest more or less isolated from the rest of the world by barriers of desert and sea, which are not readily crossed by most animals or plants. This forest is specially interesting to the naturalist on account of the fact that it contains many plants and animals of archaic type, which show great similarity to species occurring in Tasmania, Australia, and New Zealand; thus the dominant trees of the forest, as in Tasmania and New Zealand, are of the genus *Nothofagus*, a few marsupials are found, and affinities have also been traced among the frogs, molluscs, worms, and insects.

Several different theories have been propounded to account for these resemblances, the chief of which are: (1) that these regions represent the last refuges of earlier faunas and floras, which were formerly of world-wide distribution but have been crowded out of existence in the northern hemisphere through the development of newer types; (2) that the resemblances indicate a former land connexion, which may have been broken either by denudation or by the "drifting" of land masses; and (3) that, even under conditions such as exist at present, distribution may be affected by circumpolar currents in air or sea. These theories are not incompatible, and the fuller our knowledge of the existing fauna and flora the more nearly shall we be able to arrive at conclusions as to how far each may be true.

With the object of obtaining collections of insects from the Southern Andes, which it was hoped might provide new evidence bearing on the problems indicated above and reveal many new and interesting species, a joint expedition was arranged in 1926 by the British Museum (Natural History) and the Bacteriological Institute of the National Department of Hygiene, Argentina. The writer went to collect for the British Museum and Mr. Raymond C. Shannon for the Argentine Government, Mrs. Edwards and Mrs. Shannon accompanying the expedition and assisting in the work. We left England at the end of

September, and, after meeting Mr. and Mrs. Shannon at Buenos Aires, proceeded at once to the area selected. In the middle of February we returned home with a collection of over 20,000 insects, roughly estimated to include about 2000 species, of which quite half are probably new to the Museum collection and some hundreds certainly are new to science; Mr. Shannon obtained a similar set for his institution. This result must be considered satisfactory, in view of the short time we had at our disposal, although it still leaves ample scope for future investigations.

The expedition was almost like a second voyage of the *Beagle*, so many of the scenes made familiar by Darwin being revisited. The route taken from Buenos Aires was by rail to Carmen de Patagones at the mouth of the Rio Negro, which is crossed by ferry, and thence by the new Government railway from Viedma to Bariloche. Part of the country traversed is that described by W. H. Hudson, and it was fascinating to identify from the train windows many of the birds and animals described in his books: oven-birds, with their quaint mud nests on the telegraph poles; tinamous, skulking among the low shrubs; little burrowing owls; flocks of flamingoes and other water-fowl on the lagoons; rheas and guanacos. The railway is still unfinished, the last fifty miles having to be covered by motor-car over a rough track in hilly country.

Bariloche is a large village on the shores of Nahuel Huapi, a lake which for size and scenery may be compared with that of Lucerne. The broad eastern end of this lake lies in desert country, and its western arms extend far into the forest-clad recesses of the Andes, Bariloche being situated almost exactly on the boundary line between the two types of country. The transition is astonishingly sudden; in a short walk of two or three miles one can pass from the dry treeless area, which stretches away to the Atlantic coast, through a zone of bushes to quite dense forest, with large beech and coniferous trees and numerous streams and waterfalls. Ten miles east of Bariloche the annual rainfall is perhaps 10 inches; the same distance west it is 100 inches. The region round Nahuel Huapi is therefore not only readily accessible (it can be reached in little over a month from London), but is admirably suited for collecting in different types of country. The greater part of the region lies within the area recently established as an Argentine National Park.

We spent six weeks in this district, with Bariloche as headquarters, taking advantage of the friendly hospitality of settlers

in the district, among whom we should like especially to thank Mr. and Mrs. Brophy, of the Government trout hatchery, and Mr. and Mrs. Vereertbrugghen, of Lake Gutierrez, for their kind interest and assistance. To Mr. Vereertbrugghen we are indebted for most of our specimens of a very remarkable insect called *Cylindracheta spegazzinii* (Fig. 1), a wingless and almost wormlike creature which burrows in the soil by means of its modified front legs, and attacks the roots of garden plants. The first species of this genus was described long ago from specimens from Australia, and was believed to be a degenerate kind of mole-cricket; it was not until 1915 that the Argentine species was discovered, and its describer, Giglio-Tos, was of opinion that it was in no way related to the mole-crickets, but belonged to a different order of insects, the Embioptera. It is hoped that a study of our material will decide whether this is

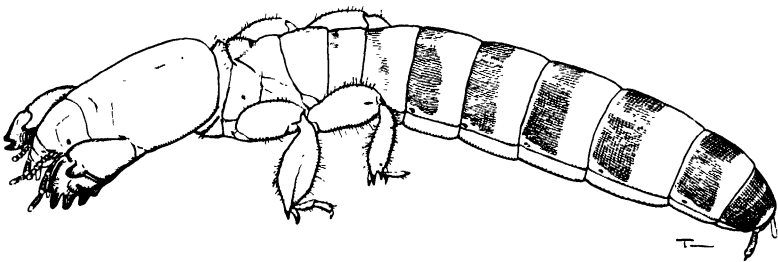


FIG. 1.—A GARDEN PEST OF NORTH-WEST PATAGONIA :
Cylindracheta spegazzinii ($\times 2$).

really a remarkable case of convergent evolution due to similar habits.

Two small steam-launches provide the chief, and in most cases the only means of communication between Bariloche and the various other "ports" or small settlements. The services are somewhat irregular owing to the frequent high winds which make navigation on the more exposed parts of the lake difficult, if not impossible. One of our excursions was made by the little steamer *Condor* to Correntoso, a northern arm of the lake, where a small wooden hotel has recently been erected, under German management, for the benefit of the increasing number of tourists who visit this region in the summer months. The forest here is heavier than at Bariloche, the climate being moister. The lower slopes of the hills up to about 4800 ft. are covered with magnificent coihué trees (*Nothofagus dombergii*), and a rather dense undergrowth of bamboo (*Chusquea*), which is difficult to penetrate unless one can find cattle tracks. This bamboo forms the chief food of the cattle, but it does not stand

much trampling and is slowly being killed off near the farms. Above 4800 ft. the evergreen coihué is replaced by another species of beech, the deciduous lenga (*Nothofagus pumilio*); the undergrowth is less dense and the snow-line (about 6500 ft.) is easily reached. The boundary between the two types of forest is readily distinguishable from a distance owing to the lighter green of the lenga. Among the coihué several other trees are found, one of the most interesting of which is the arrayan (*Eugenia patagonica*), the smooth light red bark of which has a peculiar soapy feel. On sites of old fires, and on low gravel beds, the niri shrub (*Nothofagus antarctica*) forms dense thickets through which progress is slow and often as difficult as through the bamboo, but we usually found we could get through, either by crawling underneath, climbing through the branches, or rolling over the top.

The mammalian fauna of the region is poor. The largest wild animal is the puma, which is said to be increasing in numbers and taking a heavy toll of the settlers' live-stock. We found its fresh tracks near one of our camps, but were not fortunate enough to see one. A fox and a small deer (huemul) occur in small numbers, but the animal most in evidence is the European hare, which has lately spread to this district from the eastern provinces and is regarded as a pest. Armadilloes and skunks are common (a dead skunk provided us with a number of interesting beetles), and the burrowing tucutucu can often be heard but rarely seen. We were told of a small marsupial which lives in holes in the coihué trees, but it is rare. Birds are fairly abundant and some are very interesting, among which may be mentioned: the condor, which is seen occasionally; a large grebe, which frequents rapid streams, swimming and diving in the turbulent water; a fine black woodpecker; a little gallinaceous bird (perhaps the "guid-guid" of Chiloe described by Darwin), which lives in the depths of the forest and has a peculiar call of almost human sound; and some strange penguin-like birds, a colony of which lives on an inaccessible cliff on a small island in Lake Nahuel Huapi. There is only one snake, a harmless one, but several lizards and Batrachia.

We arrived at Bariloche rather early in the season, and insects were not abundant, except for the vast numbers of fungus-gnats (*Mycetophilidæ*) among the rotting trunks in the forest. Later on, however, many more appeared, so that in spite of much bad weather we made a very successful catch, which included some rather interesting discoveries, the most important of them perhaps being flies of the family *Blepharoceridæ* (Fig. 2).



CORRENTOSO FERRY.
Looking southward over Lake Nahuel Huapi.



CORRENTOSO CHANNEL.
Looking towards Lake Correntoso.
Burnt Coihué forest with secondary growth.



CORRENTOSO CHANNEL.
A short rapid connecting Lake Correntoso with the northern arm of Lake Nahuel Huapi.

The larvæ and pupæ of these very remarkable archaic insects live attached to rocks and stones in waterfalls and rapids. Our species belong to the genus *Edwardsina*, which has an interesting history. It was first described in 1920 from material from Chile, and has subsequently been found in Australia and Tasmania. Its discovery in Australia was made by Dr. R. J. Tillyard, of New Zealand, who during a visit to Europe in 1921 read the description and thought that, if a land

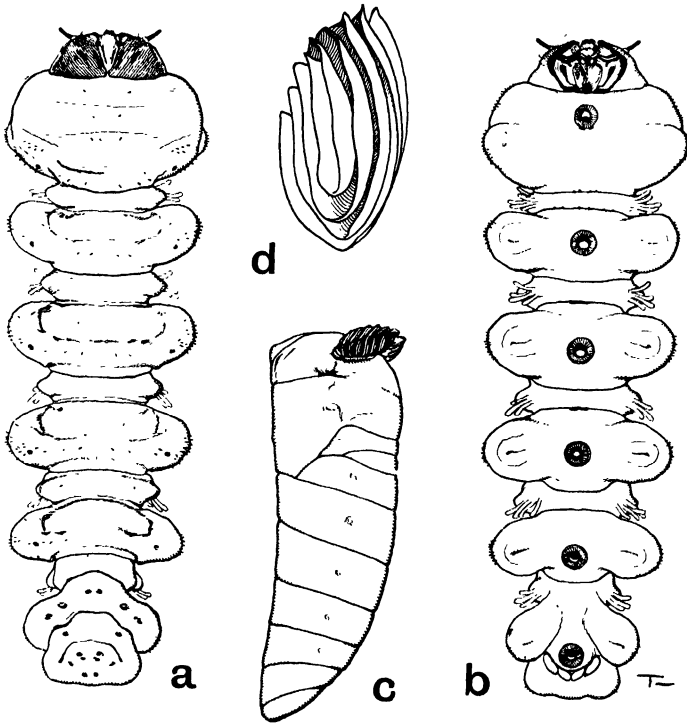


FIG. 2.—*Edwardsina* sp., FROM THE SOUTHERN ANDES
 a, Larva from above ($\times 12$). b, Larva from beneath, showing suckers for attachment to rocks. c, Pupa, side view. d, Respiratory organ of pupa further enlarged.

connexion had existed between southern Chile and Australia in Jurassic or Cretaceous times, *Edwardsina* ought certainly to have made use of it and might still exist in Australia. He therefore on his way home examined the waterfalls near the summit of Mount Kosciusko, and there found two species of this genus. These and others discovered later by Mr. Tonnoir in Tasmania differ in some ways from *E. chilensis*, but some of the species found by us in the Andes are of the Tasmanian type. Another archaic insect met with in Tasmanian streams by Mr.

Tonnoir was a small scorpion-fly belonging to the family Nan-
nochoristidæ, which was otherwise known as occurring only in
New Zealand. We hoped to find representatives of this family
in South America, and were not disappointed: two species
being found near Bariloche and another on the Chilean side. It
is astonishing that these frail insects may have lived on for ages
almost unchanged, while the continents have been sundered,
the Andes have been upheaved, and the whole evolution of the
mammalia has taken place.

Mention should also be made of the solitary wasps (Thynnidæ),
two species of which were very common wherever we went.
The males are large strong-flying insects, looking almost like
dragon-flies while on the wing; the females are very much
smaller, differently coloured and quite wingless; they are carried
about by their partners tucked away under the body. Another
conspicuous hymenopteron is the big red Chilean bee (*Bombus*
dahlbomi).

Although for various reasons we spent most of our time on
the Argentine side of the main range, we were anxious to obtain
collections from the Chilean side for comparison, and therefore
left Bariloche early in December. The journey across to the
Pacific coast is very varied and interesting, four lakes—Nahuel
Huapi, Frias, Todos los Santos, and Llanquihué—being crossed
by steam-launch or motor-boat, and the intervening stretches
on foot, or by mule, horse, or (in one section) Ford lorry. All
who have made this journey testify to the magnificence of the
scenery, even such a great traveller as Sir Thomas Holdich
maintaining that there is no more beautiful part of the earth's
surface. In the summer a regular service of boats and mules is
arranged twice a week, and the journey can be done in two days.
We spent a fortnight over it, pausing for collecting at each
stage.

The actual pass is immediately west of Lake Frias, and is an
easy climb of only a few hundred feet by a corduroy road through
dense forest. From the top there is a drop of a couple of
thousand feet to the frontier house of Casa Pangué, where we
stayed a week and made several excursions, including one to one
of the glaciers of El Tronador. This fine mountain, though only
11,000 ft. in height, is not hidden by surrounding peaks, and
therefore is a more imposing spectacle even than Aconcagua,
quite apart from its far more beautiful setting. Mr. Richards,
the English occupier of Casa Pangué, keeps an official rainfall
record, the total for last year being over 150 inches, of which
about 6 inches fell in one day in November. It is therefore not

surprising that the forest here is richer, with more abundant variety of trees and especially of undergrowth of shrubs and creepers, including a number of species of *Berberis*, also *Fuchsia*, *Buddleia*, etc. In the darker corners of the forest there is a thick carpet of moss and ferns, not only on the ground, but covering all the stems and branches of the trees, bushes, and creepers to a thickness of several inches. In swampy places a land leech was numerous and troublesome, climbing over our riding boots and getting inside. This was the only annoying pest we met with in the expedition; according to reports we received, mosquitoes and horse-flies are very troublesome later in the summer, but were rather scarce up to the time of our departure. The insect fauna is rich, and given favourable conditions the country would provide excellent collecting. We took several species of frogs and toads, including *Rhinoderma darwini*, a pretty little green species, something like the European *Hyla*. Large Tarantula-like spiders were also quite common.

From Casa Pangue it is necessary to ford the shingly Rio Tronador; not difficult to do in ordinary weather, but dangerous after heavy rain. We crossed it in an ox-cart, with several mounted Indians goading on the oxen. Once across, a Ford lorry took us most of the way to Peulla, on the shore of Lake Todos los Santos, but owing to a rise in the level of the lake, the last mile had to be done on horseback through water a couple of feet deep. From Peulla we had expected to visit a small lake in the mountains scarcely two miles distant, but found this to be impossible; the track had been neglected for three or four years and was now so much overgrown that it would require re-cutting before the lake could be reached. A fine waterfall close to the house, however, provided us with another *Edwardsina*, and the forest produced many additions to our collection, including a wood-feeding termite. Both at Casa Pangue and Peulla, as well as at other places subsequently visited, two familiar English flowers grew in profusion in the clearings: namely, dog-daisies and foxgloves.

Our next stop was at Ensenada, on the eastern shore of Lake Llanquihué. Here we were joined by Dr. Eduardo Del Ponte, a colleague of Mr. Shannon's from Buenos Aires, who rendered valuable assistance during the week he was able to remain with us. On the way thither we passed close under the white cone of Osorno, which in its symmetry rivals the more celebrated Fujiyama. Darwin described the eruption of Osorno which took place in 1833, the barren lava-fields of which can



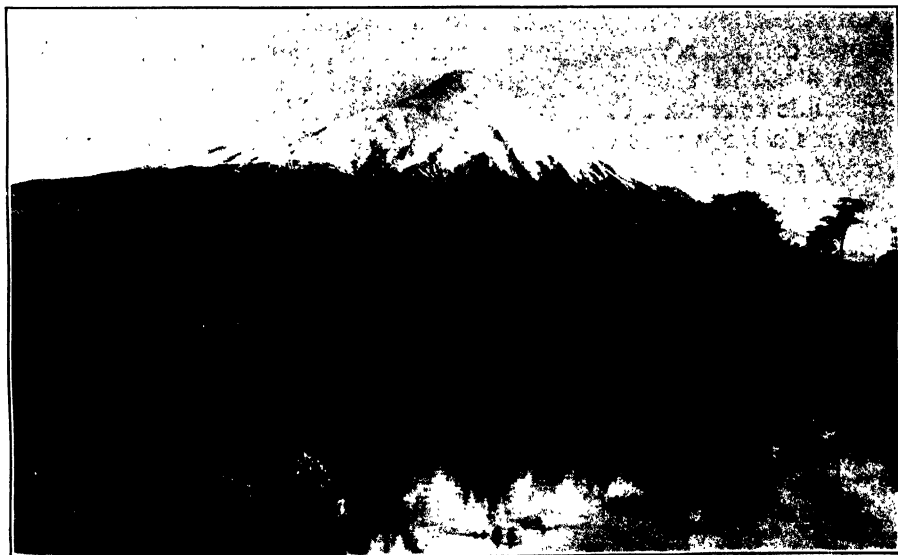
COIHUE FOREST.

West end of Lake Nahuel Huapi.
Coihue (*Nothofagus dombeyi*) and undergrowth
of bamboo (*Chusquea culeata*).



PEULLA, LAKE TODOS LOS SANTOS.

Waterfall in Coihue forest.
The foxgloves are abundant in clearings.

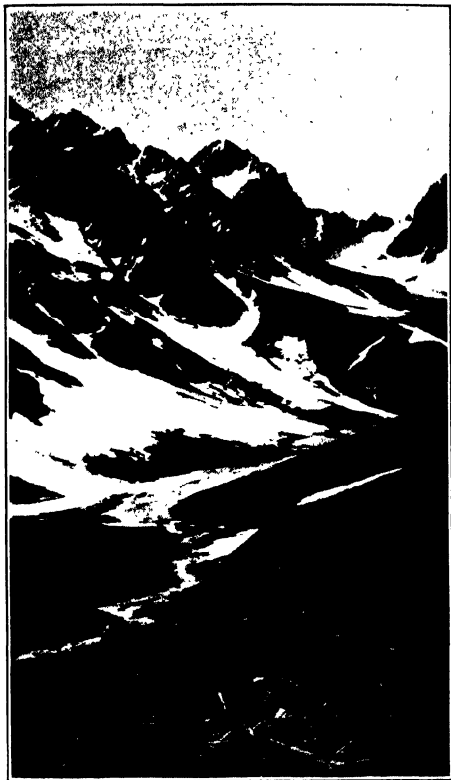


MT. OSORNO.

A dormant volcano of the Southern Andes.

still be seen, though for sixty years the volcano has been quiescent. Calbuco, on the opposite side of the lake, was active as recently as 1896, and there are still hot springs in the snow on its summit. A vivid memory of Ensenada is of the evening chorus of various species of frogs. The huge *Calyptocephalus gayi* (male and female?) called to one another with alternating cries of " Ahk-ahk ? ", " Awk-awk ! ", and another species had a remarkably clear, bell-like note. A peso or two produced specimens of the large fellow from one of the farm boys, but we failed to track down the other species, which was very wary. The country round Lake Llanquihué is now very extensively cultivated, and did not provide such good collecting grounds as we had anticipated. We therefore decided to take advantage of favourable weather and a convenient boat to visit the island of Chiloe for a few days. Landing at Ancud, formerly known as San Carlos, on December 17th, after a short stay we went by train on the little narrow-gauge railway to Castro, whence we returned after a couple of days to Puerto Montt.

Although quite prepared to find the semi-Indian inhabitants of Chiloe more civilised than in Darwin's day, we were not a little surprised to discover that the latest European fashions of silk stockings and short skirts had spread to Castro. Domestic conditions, however, are for the most part still very primitive, and education is hardly up to our standard, as we found when we went to the post office to send cablegrams home; the young lady assistant asked where England was (" Was it a post office in Great Britain ? "), and refused to believe that the United States could contain a Washington city in the east as well as a Washington state in the west. In spite of extensive clearance, it is possible to reach on foot from Castro the virgin forest which still covers a large part of the island, and we were able to obtain a very good sample of its insect fauna, especially in clearings where Indians were engaged in burning wood for charcoal, the chief fuel of the island. This forest is even denser than at Casa Pangué, and has a greater variety of trees, many of them evergreen. We borrowed an ox from one of the charcoal-burners, and used it as a bait for blood-sucking flies, which were rather numerous here and included several species of the little-known Leptid genus *Dasyomma*. The gorgeous, red flowers on the old trunks and stumps, sometimes visited by large blue Cyrtid flies, were a wonderful sight in the bright sunlight, which we were fortunate enough to experience. Although Chiloe island has been described as " one of the sloppiest in the world," it certainly did not live up to its reputation during our visit, and both at



USPALLATA PASS.
Caracoles (10,450 ft.) on Chilean side of pass.
View from train.



BREEDING-PLACE OF *Anopheles pictipennis* Phil.
Los Lores, near Los Andes, Chile.



CASTRO, CHILOE ISLAND.
Indian Charcoal-burners. Primitive forest in background.

Ancud and Castro, as well as from the train windows on the journey between the two, we were able to make quite extensive collections. One interesting find was a large, orange daddy-long-legs, belonging to a genus which has only recently been described from New Zealand material, and we also obtained two more species of *Edwardsina* of the *chilensis* type. This excursion completed the main programme of the expedition, and Puerto Montt, *viâ* Concepcion, Santiago, Los Andes, and on Christmas Day we commenced our homeward journey from Mendoza, at each of which places we paused for collecting and for visiting the museums and the local naturalists. One of our main objects in returning by this route rather than the way by which we had come was to investigate the mosquitoes of the region between Santiago and Mendoza, about which very little was known. In the north of Argentina—and also, it seems, in the north of Chile—an important malaria-carrying species (*Anopheles pseudopunctipennis*) occurs, and we wished to obtain some idea of the southern limits of its distribution. In this we were negatively successful, as we proved to our satisfaction the absence of the species on both sides of the Andes in this latitude. In this connexion we wish to record our thanks to Prof. Wolffhügel of Cayatué, Dr. Oliver-Schneider of Concepcion, Prof. Carlos Reed and Mr. Pickel of Santiago, and Mr. D. O. King of Mendoza for their kind assistance and advice.

The barren heights of this section of the Andes, and the semi-arid country at their foot, afford a striking contrast to conditions in the south. All cultivation is by irrigation, and instead of forests we have a scanty desert vegetation, with various cacti as the most conspicuous plants. On one of our excursions from Los Andes in search of *Anopheles* we went to an interesting valley full of giant cactus, and here, among patches of watercress in a small permanent stream, we found the only anopheline larvæ obtained during the whole expedition. Having made this discovery, we remained in the locality till dark, when a few adults came to bite. These proved to belong to a rare and interesting species (*A. pictipennis* Phil.) which had not been seen since it was described in 1865, and about the identity of which many conjectures had been made. This locality must be near the southern limit of distribution of *Anopheles* in South America.

In the small town of Los Andes is a memorial to the brothers Clark, the English engineers who constructed the famous Transandine railway, one of the chief means of communication between Chile and Argentina, which rises to a height of well

over 10,000 feet before plunging into the tunnel under the Uspallata pass. The journey by this railway formed a fitting conclusion to our stay in Chile, almost the last view of which was a glimpse of the lovely Inca Lake, in its rocky setting of snow-clad slopes rising to over 14,000 feet.

BOOK NOTICES.

The Herring and the Herring Fisheries. By J. T. JENKINS, D.Sc. Pp. xi + 175, with frontispiece in colour and 13 plates in monochrome. (London: P. S. King & Son, Ltd. 12s.)

Two chapters of this book are devoted to the natural history of the Herring and its principal races, the remainder being an account of the development and present condition of the great herring fisheries in Britain and other countries. The herring fisheries are so important that in recent years much attention has been given to the study of the life-history of this fish and to the habits and distribution of the different races; an adequate account of the results of these researches would require much more space than Dr. Jenkins has given to this part of his subject. Those who consider that the work of Hjort and Lea has demonstrated that the rings on herring scales are annual will be somewhat surprised at the prominence given to the generally discredited idea that a shoal of herrings may be an assemblage of fish of the same age, although differing in the number of their scale-rings.

Dr. Jenkins mentions that in the White Sea Herring the mean number of vertebræ is four less than in the Norwegian Herring. It has long been known that in this respect the Herring of the White Sea agrees with the Herring of the North Pacific, but it is only recently that it has been observed that it agrees with the Pacific Herring also in having no keeled scales in front of the pelvic fins, and is undoubtedly the Pacific species, *Clupea pallasii*, and not *Clupea harengus*. This isolated colony of the Pacific Herring in the White Sea is a most interesting example of discontinuous distribution, which would perhaps be understood if we knew the geographical and climatic changes that took place in the Arctic Ocean from pre-glacial times to the present day.

Plants of the Past: a Popular Account of Fossil Plants. By FRANK HALL KNOWLTON. Pp. xx + 275, with 90 figures. (Princeton University Press. 16s.)

NEARLY three thousand years ago a petrified cycad trunk attracted the notice of some ancient Etruscans, who placed it among other offerings on a tomb near Bologna. The Etruscans probably regarded this fossil merely as a strange and rare, perhaps magical, object, but among the Greeks Xenophanes, as early as the sixth century B.C., had grasped the true nature of fossils, and he is reported to have observed impressions of laurel leaves in the rocks of Paros. In the Middle Ages fossil plants received even less attention than fossil animals, and it is only when we reach the dawn of geological science in western Europe that we find the acute intellect of Robert Hooke, in the seventeenth century, discussing exactly how plants became petrified, and maintaining that microscopical structure is of use in recognizing fossil wood. "There often have been, and are still daily found," says Robert Hooke, "buried below the present

Surface divers sorts of Bodies . . . resembling both in Shape, Substance, and other Proprieties, the Parts of Vegetables."

These "finds of the parts of vegetables," which, accumulating in our museums during the last hundred years, have yielded so much information bearing on all branches of botanical science, are the subject of Dr. Knowlton's book. He has endeavoured, as he says in the preface, to write a connected narrative of the past history of plants, rather than a text-book of palæobotany. It is, however, as an elementary text-book that the volume will be found most useful. The specialist who is writing a popular book is often too anxious to make his subject complete and all-inclusive, and, in an endeavour to be judicial and impartial, he sometimes includes controversial matter without adequate comment or criticism. For the general reader, the main part of Dr. Knowlton's book is perhaps overloaded with detail, which would be of use only to the more advanced student. Neither in a popular work, however, nor in a text-book should there be any room, even in a footnote, for an exploded myth like the Coal Measure angiosperm mentioned on p. 162.

The first chapters include an account of how plants became fossils, with an introduction to geological and botanical classification. Then follows the detailed description, full of excellent illustrations, of the plants represented in the successive geological formations, from the exceedingly dubious "seaweeds" of pre-Cambrian times down to the plants exterminated during the last glacial epoch. At the end the author has collected several interesting essays on general topics, such as the problem of organic evolution, the influence of plant life on animal evolution, and the formation of coal.

There are very few misprints or other errors, but the remarks on European Eocene plants on p. 203 have somehow found their way into the wrong chapter, and in the legend to Figure 69 the names of the leaves are rather mixed. Fig. c is *Ficus laurophylla*, and Figs. d and e are *Menispermities* and *Fagus* respectively. In the legend to Fig. 89, *Alnus* should be *Ulmus*.

The book is written primarily for American readers—the illustrations are mainly taken from American specimens, and in an introductory chapter the author indicates in which American museums fossil plants can best be studied. For the benefit of English readers who may wish to see actual specimens, we may remark that nearly every genus of fossil plants mentioned (except a few of the American Tertiary flowering plants) is represented in the Geological Department of the Natural History Museum.

A Bird Book for the Pocket. Treating of all the regular British species, with coloured plates to scale and an illustrated chapter on eggs. By EDMUND SANDARS. Pp. xix + 246, illustrated in colour. (Oxford University Press. London: Humphrey Milford. 1927. 7s. 6d.)

IN the preface to this book the author expounds his object and methods: he has aimed at a book small enough for the pocket to contain accurate drawings in colour of the birds met with in this country, and sufficient but concise description of each on the page facing the corresponding drawing, all the birds being shown in much the same position. He further pleads with ingenuous *naïveté* that, inasmuch as there are already so many books on British Birds, another one calls for no apology, but refrains from adding (as in the classical case of the errant baby) that it was after all but a little one. The size of the book is, indeed, its most commendable feature. The illustrations in colour are, we fear, far from satisfactory and are hardly sufficient for a novice with his inexperienced eye to identify the birds which he may espy. The price too is far from cheap. We should not omit to add that the technical names of the birds are correct and up to date.

The Corridors of Time. I. Apes and Men. II. Hunters and Artists. By HAROLD PEAKE and HERBERT JOHN FLEURE. Pp. vi + 138; vi + 154; text illustrated and maps. (Oxford: Clarendon Press, 1927. 5s. each.)

THE Geology and Palæontology of the more recent periods of the Earth's history are so inevitably interwoven with Prehistoric Archæology that it has become essential for the specialists in each branch to take into full account the discoveries and progress made by those of the other branches. This applies no less to that very considerable body of readers who may not consider themselves specialists, but who yet take far more than a passing interest in one or other of the above-mentioned subjects.

The two small and compact volumes under notice will appeal not only to these two classes, but also to the ordinary reader wishful of keeping in touch with the latest discoveries and theories in the sciences of things prehistoric. There are many larger volumes dealing exclusively with more restricted fields—so many, in fact, that it would be invidious to make mention of the few that would be possible here—but there does seem to be a real need for a work such as we are now being given, for there are yet two volumes promised to continue the story begun in those just published. G. Mortillet's valuable and compact work has always seemed hampered by the small number of illustrations; the present authors have been most liberal with illustrations, maps, figures of sections, and various charts, all of which greatly illuminate the text and assist in avoiding that mental indigestion which might result from an attempt to assimilate so large an accumulation of items in so small a compass. It seems a pity that in so few of the figures is any indication given of the natural size of the object portrayed. Each volume has an index of proper names, and at the end of each chapter is given a list of books, which would easily lead the inquirer to further study of any particular phase.

Volume I covers a much wider field than the title might be taken to indicate, for it almost literally attempts to begin at the beginning, both from the mythological and geological view-points. The early chapters are followed by others on Evolution, the Descent of Man, the Ice Age (in which full prominence is given to the hypotheses of Penck), Early Tools, and the Early Types of Man up to, and including, most of the known remains belonging or allied to Neanderthal man. The volume concludes with nine pages epitomizing and drawing conclusions from the information just provided.

Volume II deals with the modern human type from his earliest known records up to a possible 4000 B.C. This includes not only his physical aspect, but also his art and industry, his different climatic and geographic surroundings, and the contemporaneous faunas which provided food, clothing, tools, and eventually his domesticated animals. The chapter (V) on Early Types of Modern Man has a most useful appendix giving a catalogue of the better-known Upper Palæolithic specimens, and on p. 131 a similar list is given of those of the latest Palæolithic age and of some British skulls; the value of these appendices would have been greatly enhanced had an indication been given of the Museum or other Collection in which the specimen is now preserved. Chapter VI on the Life and Thought of the Times seems all too short, dealing as it does with one of the most fascinating periods of Man's early history, that which produced the greatest of big-game hunters and by no means the least of painters of wild animals.

To conclude, these first volumes of a series of four may be warmly recommended, for, although there may be statements with which one may not altogether agree, a very fair and up-to-date presentation is given of the known facts and prevalent theories regarding the unfoldment of early civilization, as well as the authors' own conclusions on the subject.

The Characters of the Human Skin in their Relations to Questions of Race and Health. By H. J. FLEURE. Chadwick Trust. First Lecture in memory of Sir Malcolm Morris, M.D. Pp. 32. (Oxford University Press. London: Humphrey Milford. 2s. 6d.)

IN this interesting lecture Prof. Fleure discusses the physiological and evolutionary significance of the dermal characters of the human races. His point of view may be gathered from the following sentence: "The bodies of Europeans, and especially of the fair Europeans, with blood vessels showing through the uncoloured skin, are engines adapted to ensure emission of a large amount of heat and consequent performance of a large amount of work." Practically all the dermal peculiarities of man are to be regarded as adaptive characters, fitting each race for life in its special environment. Human love for wandering and conquest has, of course, masked the correlation between environment and skin; and it has produced striking discordances from time to time, as, for example, the Indians of the Upper Amazon, who are as much immigrants there as are whites in the tropics.

The recognition of this close correlation between skin and environment in man is of great interest to the zoologist. Close studies of comparatively small groups, rich in species or races, seem always to lead to the conclusion that the special characters of the skin and of the organs of digestion and locomotion in mammals are to be regarded generally as responses to stresses imposed upon mammals by their surroundings and special habits.

STAFF NEWS.

MR. WILLIAM JAMES ANDERSON, I.S.O., Staff Officer in the Director's Office, retired on July 31 with a service of over forty-one years, thirty-five of which were spent at the Natural History Museum. After the reorganisation of the establishment Mr. Anderson, who was serving as a Second Division Clerk of the Higher Grade, was appointed Staff Officer on April 1, 1922. A man of considerable energy, he did much service outside his official duties. He acted as Honorary Secretary to the Natural History Museum Savings Association from its inception in 1916, and to him its success is mainly due. For his assistance in connexion with the Serbian Relief during the war he was awarded the Order of Saint Sava in February 1919. He was created a Companion of the Imperial Service Order in June 1927.

* * * * *

The Trustees have appointed Dr. Leonard James Spencer, M.A., Sc.D., F.R.S., of the Department of Mineralogy, to the Deputy Keepership vacated by the promotion of Dr. W. T. Calman, F.R.S., to the Keepership of Zoology. Dr. Spencer first entered the service of the Trustees as Second Class Assistant on the old establishment on January 1, 1894.

* * * * *

Consequent on Mr. Anderson's retirement the following promotions have been made:—Mr. Thomas Wooddisse to the post of Staff Officer in the Director's Office, and Mr. George Alexander Smith, of the Department of Zoology, to a Higher Grade Clerkship. Mr. Wooddisse entered the Museum from the Second Division of the Civil Service on November 1, 1919, and Mr. G. A. Smith joined the staff as Boy Attendant on the old establishment on November 23, 1896.

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A NEW GAZELLE SHOT BY H.R.H. THE DUKE OF YORK, K.G.

By J. G. DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

HIS Royal Highness the Duke of York has recently deposited in the Museum on loan the head of a Gazelle which he shot on Great Hanish Island, in the Red Sea. The specimen on examination was found to represent a new race of Arabian Gazelle, and was described under the scientific name of *Gazella arabica hanishi* by the writer at a meeting of the Zoological Society of London on the 18th October, 1927.

This new Gazelle differs from the true Arabian gazelle (*Gazella arabica arabica*) in the following particulars: the dark marking on the nose is much larger and more sharply defined in this new form, the black hairs extending nearly all along the muzzle, whereas in the Arabian gazelle this marking is more of an isolated patch; on the forehead, at the base of the horns, there are two blackish spots, which extend down the face almost as far as the dark marking on the nose, whereas no such dark spots are found on the head of the Arabian gazelle.

The general colour of the back and upper parts is considerably less rufous than in the typical Arabian species, and from photographs the dark stripe on the flank appears to be more definite. In this latter respect His Royal Highness's specimen more nearly resembles one of the two mainland gazelles, *Gazella arabica erlangeri*, which is found in the country to the north of Aden, but here again this new form is distinguished by its far less rufous colouring and larger and more definite nose marking.

In Syria there is another allied gazelle, *Gazella arabica rueppelli*, which is, however, a much paler animal, in colour resembling more the well-known Dorcas gazelle from Palestine, Syria, and North Africa; the nose in this Syrian gazelle is reddish-brown in colour with a distinct blackish spot. The true Arabian gazelle—that is, the typical race, *Gazella arabica arabica*—is from the Farsan Islands, which lie some two hundred miles north of Great Hanish Island, the locality of this new race.

The horns measure 9 inches in length, $3\frac{3}{8}$ inches in girth, and $4\frac{1}{8}$ inches from tip to tip. The mainland races appear to have



H.R.H. THE DUKE OF YORK'S NEW GAZELLE.

rather larger horns, the record being a specimen from the hinterland of Aden measuring $12\frac{1}{4}$ inches in length, $4\frac{3}{8}$ inches in girth, with a tip to tip interval of $5\frac{1}{4}$ inches. His Royal Highness the Prince of Wales owns a specimen from Great Hanish Island, the horns of which measure $6\frac{3}{4}$ inches in length and $2\frac{7}{8}$ inches in girth. The record Syrian head carries horns of $10\frac{3}{4}$ inches in length, $4\frac{3}{4}$ inches in girth, and a tip to tip interval of $4\frac{3}{8}$ inches. The Dorcas gazelle, which may be regarded as a close ally of the Arabian, carries considerably longer horns, good horns measuring from 13 to $13\frac{1}{2}$ inches in length, and the Edmi, or Atlas gazelle (*Gazella cuvieri*), has still longer horns, the record being as much as $14\frac{7}{8}$ inches.

His Royal Highness's specimen will shortly be placed on exhibition among the Gazelles in the Lower Mammal Gallery.

STRANDED WHALES AT DORNOCH FIRTH.

By M. A. C. HINTON, Deputy Keeper of Zoology.

MANY problems of scientific interest and economic importance concerning the breeding, growth, and longevity of whales await solution. For some years it has seemed that this solution would be found only when advantage was taken of the comparatively rare opportunities for the examination of large schools of whales. On the coasts of northern Scotland, Orkney, and Shetland large schools of Caa'ing Whales have from time to time been stranded by accident or in consequence of attacks made upon them by fishermen and others.

On the morning of the 21st October last a telegram was received from the Receiver of Wreck at Invergordon stating that "one hundred and two bottle-nosed whales" had been stranded in his district. Not a moment was to be lost; eagerly I interrupted the luncheon of the Keeper of Zoology, and represented the importance of taking this opportunity of studying a school of whales. He viewed the suggestion favourably and the Director sanctioned my visit to Scotland. Mr. P. Stammwitz, the preparator, accompanied me, and I enlisted the co-operation of Mr. J. L. Chaworth-Musters, who in view of a future enterprise wished to do a little whale work with me. Hastily we made preparations for a long week-end of strenuous work, and at midnight were in the train rushing

away for Invergordon and the Cromarty Firth. Late next evening we arrived at Invergordon, and stepping out into pouring rain we were met appropriately enough by the Receiver of Wreck.

On the journey we imagined that we were going to find all the whales lying on a nice sandy beach extending possibly for a couple of miles or so. A panoramic view, two or three photographs each of the best bull, the best cow and a calf, a census of the school, measurements, some quick dissections of the females, the collection of two or three good skeletons and a



BEACH AT CREICH, SUTHERLANDSHIRE.

View of temporary whaling station, taken at low tide and looking up Dornoch Firth towards Bonar Bridge.

series of skulls—and our work would be done. “Home on Wednesday or Thursday” was my rash remark; but that dream was soon shattered.

To begin with, the Receiver of Wreck told us that the whales were not in the Cromarty Firth at all, but in the Dornoch Firth, and thought that they were mostly near Ardgay and Bonar Bridge, although he had not seen them. Next day (Sunday, the 23rd October) we drove over to Bonar Bridge in the rain. Between Ardgay and Bonar Bridge the road passes close to the shore of the Dornoch Firth over a broad tongue of alluvial land, and there we got our first glimpse of the stranded

whales. Jumping out of the car, we made our way across a little field and in a few yards found about a dozen of the whales lying upon the high-water line. A glance showed that they were not Caa'ing Whales, as had been anticipated; their peculiar heads, very large teeth, remarkable flippers, and black colour at once attracted our attention, and in a few minutes I satisfied myself that we had to deal with a school of False Killers (*Pseudorca crassidens*, Owen), hitherto regarded as one of the rarest cetaceans. Looking out over the Firth, we saw a great many of the peculiar flippers sticking up out of the water like the flags



BEACH AT CREICH, SUTHERLANDSHIRE.

Similar View showing whales just below high-water mark awaiting examination and flensing.

of submerged ships. Inasmuch as the dead whales float upon one side and are more than half submerged, each flipper visible indicated a dead whale. So many flippers were to be seen that I thought that all the whales were gathered together in Ardgay Bay; and it looked so easy to collect them that I still had hopes of returning within a week.

What zoologist could care two straws for Highland rain with a school of False Killers before him? A merry, though wet party of five (I could not leave our cabby out on such an occasion) sat down to lunch in the Bridge Hotel, and during that meal I began to learn something of the peculiarities of the

Dornoch Firth and of the difficulties before us. Someone—I believe it was the cabby—advised me to see Sir Robert Brooke at Fearn as soon as possible, and, as events proved, no man ever gave sounder advice. So in the afternoon the Receiver of Wreck and I called on Sir Robert. It appeared that, inasmuch as the local people feared that the whales would soon decay, become a nuisance and imperil the public health, Sir Robert, as chairman of the Ross-shire County Council, had taken the matter up with both the Public Health authorities and the Board of Trade; and it appeared that, unwilling to wait for departmental decisions, he was making arrangements to tow the whales out to sea as soon as possible. We had therefore arrived not a moment too soon, so that quick decisions have their advantages. I grew eloquent on the importance of *Pseudorca* from a scientific point of view, gave my personal undertaking that no whale would go rotten in less than six weeks, promised to remove at once any whale that did go rotten, and in the end persuaded Sir Robert to hold his hand. After some further discussion of plans we returned to Invergordon, soaked with rain but elated with success.

The following day (Monday, the 24th October) we had a busy morning in Invergordon, telegraphing the news to the Museum, making financial and other arrangements, and purchasing supplies for the coming work. We then proceeded to Bonar Bridge, where we established our base. As the result of consultations with Sir Robert Brooke and Mr. A. M. Chance of Spinningdale (brother to the well-known ornithologist), we decided to open our whaling station on the beach at Creich on the Sutherland shore of the Firth, and immediately opposite to Sir Robert's estate. Sir Robert Brooke and Mr. Chance very kindly volunteered to collect and tow as many of the whales as possible to the beach at Creich with their motor-boats; but for this most liberal assistance our work could not possibly have been done.

Tuesday (the 25th October) was spent in examining the beach at Creich, in finding suitable men, and in negotiations with interested parties. Next day we began work with six men from Bonar Bridge. They had to be trained to cut up the whales quickly, to leave parts required for scientific investigation, and to find the pelvic bones. They took a great deal of interest in the work, and in a few days became quite expert. Later we were able to double the number employed, and on some days have had as many as twenty men working at our station.

Sir Robert Brooke with his motor-boats *Wave* and *Fram*, and Mr. Chance, assisted by his wife and Mrs. Russell, his daughter, with his motor-boat *Alona* towed large numbers of whales off the shores and shoals, and, buoying them in deep water, formed dumps in the Firth, from which we towed them to the station as required. The collecting and towing of the whales was the most difficult part of the job. The whales were scattered up and down the Firth from Tarbat Ness to a point in the Kyle of Sutherland six miles above Bonar Bridge; that is to say, the chain of whales was thirty miles long. Some



GROUP OF WHALES ON BEACH AT CREICH, SUTHERLANDSHIRE.

were lying high and dry on grassy banks where an unusually high tide had left them; others were stranded on sand and mud banks accessible, with more or less difficulty, only at certain states of the tides and in favourable weather; lastly, a good many whales had sunk and could only be retrieved at low water. The swift tidal currents of the Firth, its shallowness, and the intricate and uncharted courses of the navigable channels would have been sufficiently formidable by themselves; in combination with adverse winds they rendered work upon the Firth impossible for days together. Such good use was made of the opportunities for this part of the work, however, when

they came, that the station never lacked material and no man employed lost a single hour's work.

We decided to send a large bull and a large cow up to the Natural History Museum to be cast. That proved to be a formidable undertaking. Flensing at our station was performed between tide-marks, and we had no means of lifting such heavy weights from the waterway on to the green grass. The road to our station was also much too steep and too bad to allow such weights to be hauled up the steep side of the Firth to the high-road a mile away. The specimens selected had to be prepared on our beach, towed down the Firth for two miles to a place called the Dun of Creich, where they were hauled from the water by men and horses, packed in sacking, placed upon a horse lorry, and dragged up the hill. The gutted female, which went first, weighed 22 cwt.; the gutted bull 34 cwt.

It must not be supposed that all went smoothly after our start on the 26th October. On the contrary, all sorts of difficulties began to arise. The various Departments that had been approached before our arrival began to move. It was disconcerting, for example, one afternoon to be interrupted by the arrival of three men, each representing a different Authority, and each determined to remove the whales at once. The souvenir hunter was always present, and he did a good deal of damage to the specimens near the road between Ardgay and Bonar Bridge. To protect our collections and raw material we had to establish duty on Saturday afternoon and Sunday at our station. The question of the disposal of refuse became urgent and at one moment looked so hopeless that we surveyed the way from our hotel to the station contemplating a possibly hurried departure. In the end, however, patient negotiation overcame all troubles. We entered into partnership with the Board of Trade; as the result the Firth will be completely cleaned and the Museum will get all the material.

The British Museum (Natural History) is now the most popular institution in this part of the country. When we arrived one worthy began to talk to me about the "awfu' calamity" that had descended upon the shores of the Dornoch Firth. I met him again some days later and his views had completely changed. Bonar Bridge had received a very good advertisement, so far as the able-bodied men were concerned unemployment had disappeared, transport people were busy and so was the hotel, the whales were being put to good use in Leith and in London, and there was no waste at all. And so,

reviewing events, he had come to the conclusion that the "awfu' calamity" was a blessing and he was going to pray for more.

Our work at Bonar Bridge ended on the 5th December, when we returned to London. During our stay we collected and flensed 126 whales (including the two sent in the flesh to London, and from these we have prepared 124 skeletons. It is probable that we shall receive further material, for some whales appear to have sunk in some of the deeper channels of Dornoch Firth, and from time to time these will come to the surface. Before leaving Bonar Bridge we made arrangements for their



HEAD OF FALSE KILLER WHALE.

One of the largest bulls : measured 18ft. 5in. in length.

disposal; three of these sunken whales have been recovered since our departure from the Firth, and their skeletons are now on the way to the Museum.

As regards the scientific results of the expedition I can say very little at present. We have done what I think has never been done before—made a complete examination of a large school of whales, and have collected the largest series of cetacean skeletons ever brought together. The data collected will, when analysed, throw light on many of the general problems that I set out to solve. The fact that our subject happened to be an unexpected and very rare species was fortunate, although

relatively unimportant. Our examination leads us to believe that *Pseudorca* feeds exclusively upon cuttle-fish, and from what we have learned we are inclined to believe that it was an unusual influx of warm Atlantic water into the Moray Firth that brought to the vicinity of the Dornoch Firth first the cuttle-fish and secondly this rare whale.

RECENT BOTANICAL EXPLORATION IN THE MOUNTAINS OF EASTERN TIBET AND WESTERN CHINA.

By R. D'O. GOOD, M.A., Assistant, Department of Botany.

AT its eastern end the great mountain range of the Himalayas, which, like the rampart of some vast prehistoric earth-work, separates the plains of India from the plateaux of Tibet, becomes lost in the intricacies of one of the largest and most complex mountain systems in the world. The greater part of these mountains lies politically in three countries, Burma on the south-west, Tibet on the west and north-west, and China on the east. It is a country "planned on nature's grandest scale," a country of towering snow-clad ranges, deeply intersected by the gorges of mighty streams, and through it pass all the great rivers which reach the sea between the Bay of Bengal and the Gulf of Pechin. These are the Irrawaddy, the Salween, the Mekong, the Yangtse, and the Yellow River, and, although the mouths of the first and last are separated by a coast-line of many thousand miles, the sources of them all are within a few hundred miles in the plateaux beyond the mountains. For some distance in their upper reaches the Irrawaddy, the Salween, the Mekong, and the Yangtse run parallel to one another all within the width of a single degree of longitude, and it is especially the story of the exploration and exploitation of this more restricted region of the great river gorges that is told in the following pages (Fig. 1).

During the latter half of the nineteenth century a number of travellers, many of them French missionaries, made small collections of the plants in the more easily reached parts of the western Chinese mountains, but it was not until almost the close of the century that the great floral wealth concealed and guarded by the inaccessibility of the interior was realized.

This was largely due to the efforts of Dr. Augustine Henry, whose collection, although made no further west than Ichang

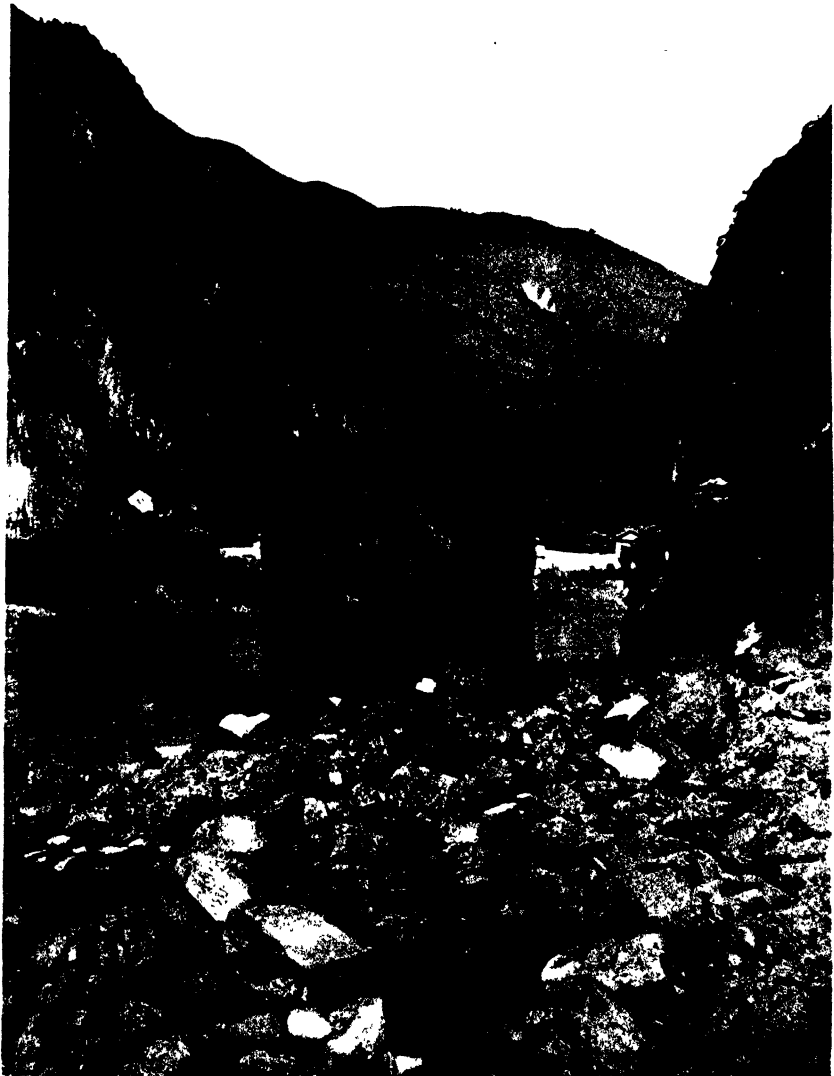


FIG. 1.—A CHINESE CHAIN SUSPENSION-BRIDGE IN THE GORGE OF THE MEKONG.

in Hupeh and Szemao in Yunnan, was sufficient to indicate clearly the possibilities of an attack upon the main mountain mass, not only from the purely academic but also from the

horticultural point of view. As a result of Henry's representations the late Sir Harry Veitch, head of the famous horticultural firm, decided to send out a collector. For this work E. H. Wilson, a young man then training as a gardener at Kew, was selected and commissioned to go to China to collect seeds and living plants likely to be of value in home gardens. Wilson left England in 1899 and proceeded first to Ichang and Szemao, where he began his work under the *ægis* of Dr. Henry. His trip was so successful that he subsequently made several other journeys, penetrating to the Tibetan border, 1000 miles west of Ichang, and also retracing some of his earlier steps. Latterly he worked on behalf of the Arnold Arboretum at Jamaica Plain, Massachusetts, and specialized in shrubs and trees. Wilson's early success fired the enthusiasm of others, and in 1904 he was followed by George Forrest, who travelled for three years, chiefly in Yunnan, and who also was employed in the horticultural interests of this country. Forrest has continued his journeys at regular intervals ever since and has now made five, returning from each with abundant collections and new plants. Like Wilson and more recent workers, Forrest, besides collecting seeds, has made enormous collections of dried and pressed specimens, accompanied by very full and valuable field-notes—a collection which is by now probably the finest ever made by a single person (Fig. 2). In 1914 Reginald Farrer entered the lists and explored, on his first trip, some of the mountains in the western part of the Chinese province of Kansu. At the close of the war he commenced a second expedition, but this, alas, ended in disaster. After making a valuable collection Farrer became seriously ill, and died on October 16, 1920, near the Chawchi Pass on the Burma-Chinese frontier, and a life of extreme promise was thus brought prematurely to an end. Meanwhile in 1911 Kingdon Ward, son of the late Professor Marshall Ward of Cambridge, commenced a series of expeditions which have continued since almost without intermission. In these last sixteen years he has travelled not only in western China but also in Tibet and north-eastern Burma, and has made many important botanical discoveries. At the time of writing he has just sailed on his tenth expedition, this time to the Naga Hills of Assam, and the results of this latest venture will be awaited with much interest. Ward, unlike the other collectors mentioned, who usually collect intensively over a comparatively limited area, prefers to work less thoroughly over a larger region. His results thus tend to be less in quantity but of a very high quality.

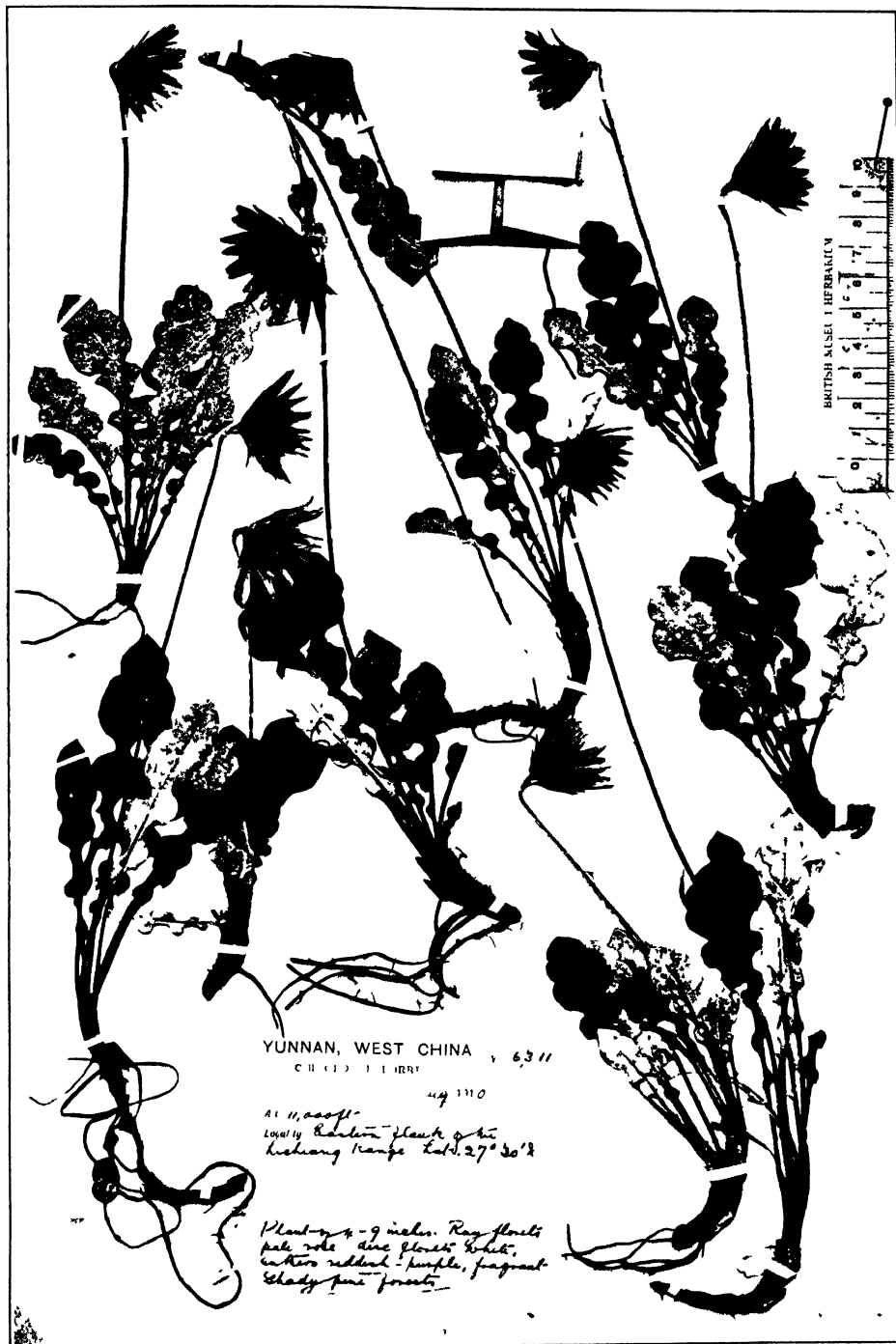


FIG. 2.—AN EXAMPLE OF FORREST'S COLLECTING.

Note the abundant material of complete plants in flower and the full field notes on the label.

It was not until 1914 that other countries entered the field. In that year Dr. Handel-Mazzetti of Vienna commenced a journey which lasted four years and covered a great part of south-western China. Since the war J. F. Rock, an American citizen, has made big collections in parts of the same regions, and more recently still Chinese nationals have taken up the work.

This very brief and bald chronology of the events by which a country, but a few years ago one of the least known has, in so short a time, become familiar to a very wide public, gives little idea of the difficulties and dangers of such botanical exploration. Apart from the inevitable perils associated with difficult country, where the forces of nature present a bewildering array of obstacles to the advance of man, and where convenient bases are few and far between, there is the continual anxiety of the uncertain attitude of the natives, who look with suspicion and apprehension upon the ever-increasing tide of Western penetration. It says a very great deal for the unfailing diplomacy and tact of the collectors that such a vast amount of work has been accomplished without disastrous consequences.

Nevertheless, there has been a full share of personal danger, as will be realized by the brief narration of Forrest's experiences during his first journey.* At this time various circumstances and occurrences had raised to danger heat the ever-present hostility of the Tibetan lamas towards the French Protestant missionaries and were made the excuse for a concerted attack upon the mission station at a place called Tzekou, where Forrest happened to be staying as the guest of the two resident priests. Although rumours of danger had reached them, these brave men, unwilling to spread panic among their followers and loath to leave the scene of a lifetime's labours, neglected to provide a way of escape in case of necessity, and when the attack came it was too late for them to save themselves by flight. The whole party of about 80 Christians was overwhelmed and 65 of them, including the two missionaries, were either murdered or thwarted their executioners by self-destruction. Of Forrest's own collectors only one escaped. Forrest himself was hotly pursued and succeeded in evading capture and death only by plunging into the woods and, by great good fortune, throwing his pursuers off his tracks. This was only a temporary relief, for the Tibetans were now bent on his destruction and for this purpose surrounded the area in

* This is an abstract of the much more enthralling account written by Forrest himself in the *Gardener's Chronicle* for May 21 and 28, 1910.

which he lay concealed. For eight days he remained hidden by day, and by night tried to find a way out of the net which was gradually closing round him. On one occasion he was actually seen and fired at; on another he was discovered by the Tibetans' dogs. He was obliged to discard his boots for fear of leaving tracks and his feet suffered cruelly, and, added to all this, he had eaten only a handful of peas which he had found spilt on a road. Fortunately he had managed to retain his rifle and revolver, and when it became evident that he must soon be found or die of exhaustion he determined on a desperate measure. This was to hold up a native hut and to compel the occupants to give him food so that he might regain a little of his strength to continue his attempts to escape. To his astonishment and relief the natives whom he approached proved friendly, and not only gave him food and shelter but also, after many and great anxieties, succeeded in smuggling him through his enemies to a friendly town. But relief from his pursuers was not the end of his troubles; in his weakened state the sharp base of a cut bamboo stem, upon which he had stepped, penetrated his foot and caused a wound from which he suffered for months afterwards.

After such an account as this it will certainly be asked whether or not the results have been worth the time, danger, and expense involved. It can be said at once that, from every point of view, the results have more than justified the most sanguine expectations. First and foremost, it has been shown that the flora of these Tibetan-Chinese mountains is the richest temperate flora in the world, a fact which has a most profound bearing upon many important biological problems and especially those of plant-geography. Enormous collections of this wonderful flora have been made and form a store of material it will take many years fully to work out, but which is all the time revealing facts of great scientific interest. These collections are mainly concentrated in the Herbarium of the Royal Botanic Gardens, Edinburgh, but duplicate sets have been distributed to Kew and to the Natural History Museum as well as to some continental Herbaria. Incidental to the making of these collections has been the accumulation of a huge mass of miscellaneous information of value to workers in many scientific fields, and the geographer, the geologist, the mineralogist, the zoologist, and the anthropologist all owe a debt to these expeditions. This information has been made all the more accessible by the fortunate circumstance that all the collectors have been possessed of the pens of ready writers and have described their

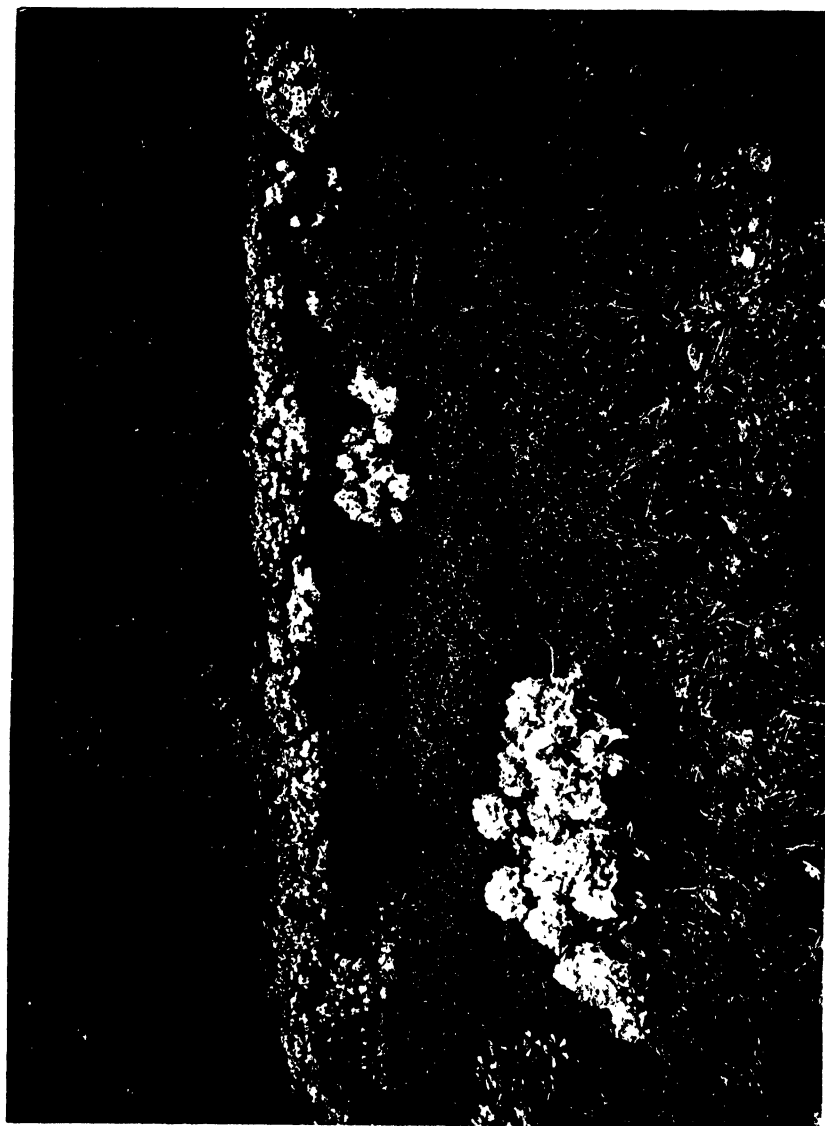


FIG. 3.—*Rhododendron Fortunei* AT ABOUT 12,000 FT.
Open coniferous forest in the background.

journeys either in book form or as serials in horticultural publications. Even in these days of multifarious literary output it may be confidently stated that much of this writing is in the front rank of travel literature.

From the horticultural side the results have been even more spectacular, and great numbers of valuable garden plants have been successfully introduced into this country. It is difficult to give concisely any adequate description of the vegetation of this wonderful mountain region, but it is best described by saying that it is a flora like that of the European Alps, but magnified and glorified almost beyond imagination. At the lower levels and in the gorges the hill-sides are covered with dense forests of hard-woods and conifers, concealing an undergrowth of a varied richness; above the forests are open alpine meadows and rocky screes reaching to the snow-line and forming a huge natural rock garden stocked in Nature's most prodigal fashion. Many of the plants of these two zones belong to groups or genera which, nearer home, are represented by only a few comparatively humble species, but here have developed in all sorts of unexpected ways. Especially is this region the home of Rhododendrons, Primulas, and Gentians; and hundreds of new species of these, covering a range of structure and beauty hitherto unknown, have been discovered (Fig. 3). A peculiar feature of the flora is the large proportion of endemic species it contains, *i.e.* species which are found nowhere else. This is particularly true of the plants just mentioned, and it is probably no exaggeration to say that two-thirds of all the known species are to be found only in these mountains. Even within this region itself most of the species are restricted to a single mountain range or river valley.

What is true of Rhododendrons, Primulas, and Gentians in the extreme is also true of many other plants in less degree, and among these may be mentioned Magnolias, Barberries, Campanulas, Honeysuckles, Cotoneasters, and Cherries, all of which are represented by a surprisingly large number of forms. Still other genera here take on quite an unfamiliar guise, as is the case with *Meconopsis*, a genus of Poppies. Familiar in Western Europe as a single small species with a yellow flower, it has, in these Asiatic mountains, a number of species most of which are handsome plants with most attractive mauve or pale blue flowers. In short these mountains have a flora in comparison with which that of the European Alps pales to insignificance. The value of such a region as a source of garden plants needs no emphasis. Composed largely of genera familiar

in our own wild-flowers, it provides just those kinds of plants which would be most likely to take kindly to an English climate. A surprisingly large proportion of the introductions have proved suited to cultivation in this country, and the list of failures is remarkably small, chiefly made up of the higher altitude alpine species which cannot stand the damp and sunless English winter. The successful species have been propagated and widely distributed, and there can now be but few British gardens which do not owe at least some part of their interest and beauty to the exploration of the Tibetan-Chinese mountains.

One result of this work, perhaps less tangible but indirectly of the very highest importance, may be mentioned as an epilogue to this article. The work of the last twenty years has shown what can be done by competent collectors adequately endowed and equipped, and that contribution to such an end is one of the most direct and satisfactory ways of advancing the cause of science.

Figs. 1 and 3 are reprinted, by kind permission of the editor, from the *Journal of the Royal Horticultural Society*, vol. 49, 1916-17.

THE FISH-BEDS OF DURA DEN.

By ERROL I. WHITE, B.Sc., PH.D., Assistant, Department of Geology.

ONE of the most striking exhibits recently completed in the Department of Geology is a large slab from the renowned fish-bearing deposits of Dura Den. This slab is actually part of the floor of an Upper Old Red Sandstone lake, now hardened into a saffron-coloured sandstone upon which the black remains of the fossil fishes show up like exquisite carvings.

Dura Den is a picturesque little valley set in the gently undulating countryside of Fifeshire. Through it runs a stream that has carved its bed out of the yellow sandstones of which the fish-beds form part, and it is along the banks of this stream that the fossils were discovered. The richness of the deposit is amazing, for the slabs are literally crowded with the beautifully preserved remains: on one occasion over a thousand specimens were discovered on one square yard of sandstone, and the slab in Geological Gallery VI has no fewer than 120 fishes on its surface.

The cause of the entombment of such vast numbers is a little

uncertain, but some light may be thrown on the problem by recent happenings of a similar nature. Clearly, from the fresh state of preservation of the individuals, burial must have been very rapid, or the remains would have decomposed and become scattered, as has, indeed, usually been the case. It is well known that many fishes, such as the carp and more particularly the lung-fishes, now living in waters that become periodically

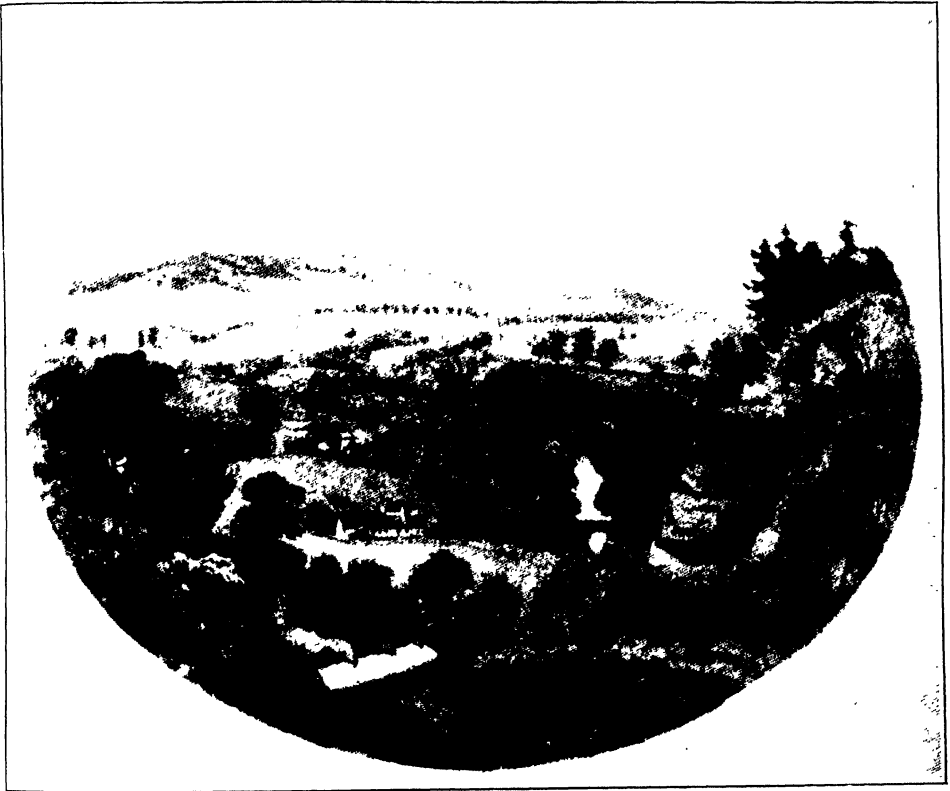


FIG. 1.—A VIEW OF DURA DEN
(From John Anderson's *Dura Den*, 1859)

stagnant, have a habit of burying themselves in the mud at the bottom of the river or lake as the waters become more and more foul during the dry season, and of staying there until the advent of the rains brings a new supply of fresh water; occasionally the dry season is prolonged and the waters disappear entirely, with the resultant death of the inhabitants. Such an occurrence as this would not only account for the excellent state of preservation of the individuals, but also for

their large numbers and for the small extent of the fish-bearing strata.

Although the number of specimens is large, only six species are represented, and all these, of course, belong to forms that have been long extinct: indeed, the most curious forms disappeared with the close of the Old Red Sandstone era, and were

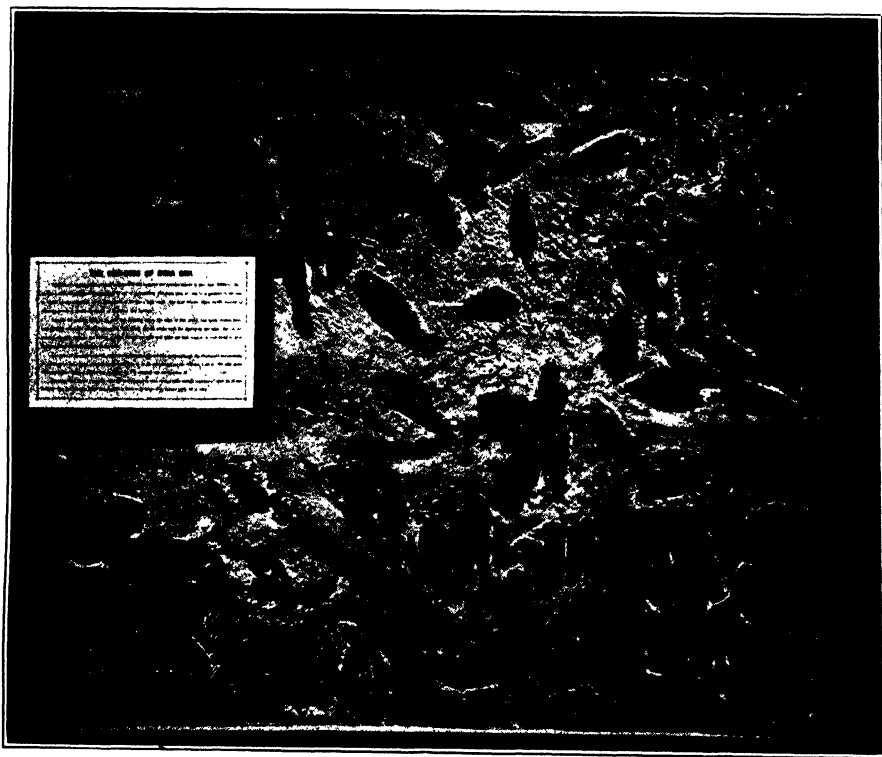


FIG. 2.—PORTION OF THE FLOOR OF THE OLD RED SANDSTONE LAKE OF DURA DEN AS NOW MOUNTED IN THE GALLERY OF FOSSIL FISHES.

The floor, now hardened into a yellow sandstone, is covered with the remains of long extinct fishes. This slab measures 6 × 7 ft.

replaced by fishes more akin to modern types, of which they were the ancestors.

Perhaps the strangest of all these forms was *Bothriolepis*, a small creature, about 6 inches in length. Its appearance was extraordinary, for it looked like some fantastic monster of heraldry, half turtle, half fish. The likeness of the forepart of this fish to a turtle is very striking: there was the same strong carapace, armoured head and flippers which are typical of the *Chelonia*, but there was no neck, and from the hinder end of

the carapace protruded a normal fish's tail, complete with dorsal fin. This tail was soft and has perished in all the specimens from Dura Den (Fig. 3).

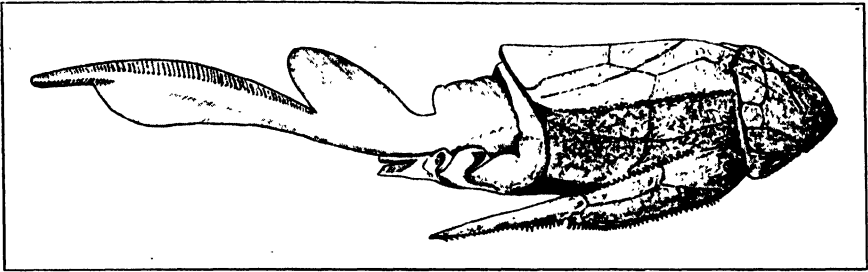


FIG. 3.—RESTORATION OF *Bothriolepis* (AFTER PATTEN).

The second fish, *Phyllolepis*, was superficially not unlike *Bothriolepis*, in that it had an armoured head and body; but the head was large and square with a pair of well-developed projections on either side, and there were no paddles. It is the rarest fish found at Dura Den, and so far only one complete specimen (Fig. 4) has been discovered: this is preserved in Centre-case B in the Gallery of Fossil Fishes.

The other four fishes were much more normal in appearance; they too were armoured, but the armour was in the form of scales and not large plates. The first of these is *Phaneropleuron*,

a lung-fish. In this type of fish the air-bladder is developed into a lung-like apparatus, which enables it to breathe air directly



FIG. 4.—PHOTOGRAPH OF THE ONLY COMPLETE SPECIMEN OF *Phyllolepis concentrica*.

as well as by means of its gills through water—a great advantage to inhabitants of waters likely to become periodically foul. Its scales are small and rather delicate, so that the internal skeleton is often seen through them. Lung-fishes still exist in Australia, Africa, and South America.

The last three fishes belong to the group of Crossopterygians, the chief peculiarity of which was that the paired fins were formed with a central axis fringed on either side with delicate rays, like those of the lung-fishes. *Glyptopomus* and *Gynoptychius* are forms seldom found well preserved. Their bodies were elongated, and breast-fins leaf-shaped. The majority of the fishes of Dura Den belong to one species, *Holoptychius flemingi*, and more than one hundred of those on the slab are referable to this form. This was a stout, round-bodied fish which grew to a length of $2\frac{1}{2}$ feet. Its breast-fins were long and narrow, and the body was covered with thick scales, of which the surface was ornamented with prominent ridges that gave the fish its scientific name (*Holoptychius* = all-wrinkle).

This completes the fauna of Dura Den. Although small, it gives a valuable insight into the life of this inconceivably remote epoch; but it must be remembered that this represents only one aspect of life of the period, namely, the life of the desert lakes. The fauna of the sea is more widely spread and contains a more diversified assemblage than that of the desert, which is naturally limited both in variety and in numbers; indeed it is only by a fortunate accident such as occurred at Dura Den that we have gained what little knowledge we have.

A BOOK BELONGING TO LADY HAMILTON.

By C. DAVIES SHERBORN, Bibliographer.

AMONG the recent acquisitions by the Library is a copy of “Continuazione delle dissertazioni sopra varj fatti meno ovvj della Storia Naturale del P. Antonio Minasi Domenicano Professore di Botanica pratica nell’ Archiginnasio Romano, detto Ia Sapienza. Dissertazione seconda su de’ timpanetti dell’ udito scoperti nel Granchio paguro e sulla Bizzarra di lui vita. Con curiose note, e serie riflessioni All’ illustrissima Signora Laura Bassi Bolognese. Napoli MDCCLXXV. Nella Stamperia Simoniana Con licenza de’ Superiori.”

The inscription in ink, now somewhat faded, runs: "Oggi 15 Giugno d.a Milady Hamilton in segno d'aver fatta conoscere all' autore Madama Swinburne." (This 15 June given to Milady Hamilton in token of having made Madame Swinburne known to the author.) The Milady Hamilton was Emma Lyon, the wife of

CONTINUAZIONE
DELLE
DISSERTAZIONI
SOPRA VARJ FATTI MENO OVVI
DELLA
STORIA NATURALE
DEL
P ANTONIO MINASI
DOMENICANO

Professore di Botanica pratica nell' Archiginnasio
Romano, detto la Sapienza.

*Oggi 15. Giugno d.
a Milady Hamilton
in segno d'aver fat-
ta conoscere all' auto.
Madama Swinburne*

TITLE-PAGE AND INSCRIPTION.

Sir William Hamilton, so well known for her association with Nelson, and Madame Swinburne was Mary, daughter of Edward Beddingfield and wife of Henry Swinburne, the traveller. The Swinburnes lived at Naples 1777-1779. Swinburne, who had previously produced "Travels through Spain," 1775-1776, wrote "Travels in the Two Sicilies," 1777-1780.

TWO EXTINCT GIANT TORTOISES.

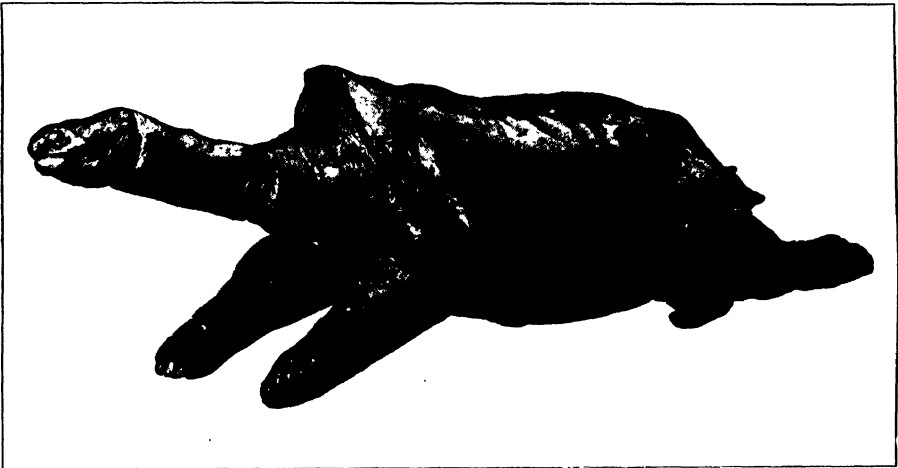
By H. W. PARKER, B.A., Assistant, Department of Zoology.

THE Museum has recently received two accessions of Giant Tortoise material which are worthy of attention by reason both of their nature and of their associations. The first of these, which was presented by Lord Rothschild, F.R.S., is a cast of the unique complete specimen of *Testudo vosmaeri* in the Natural History Museum of Paris. This species formerly occurred in large numbers on the island of Rodriguez, but became extinct late in the eighteenth or at the beginning of the nineteenth century, and was known only from travellers' narratives and from incomplete shells and bones until nearly a century later, when the stuffed specimen now in the Paris Museum was unexpectedly discovered amongst the natural history collections of the library of Sainte Geneviève.

Of the many species of Giant Tortoises known from the islands of the Indian Ocean and the Galapagos Group the vast majority have now utterly disappeared, and the few survivors are but a melancholy reminder of the destruction which has so frequently accompanied the advent of man. Though the tortoises of Rodriguez are amongst those which have vanished, it is from the early accounts of them, known to us thanks to the researches of Vaillant and Milne-Edwards, that it is possible to obtain perhaps the best picture of the former abundance of these helpless creatures and of their destruction. The earliest known account of Rodriguez is contained in a book by François Leguat, published in 1708; the author, with eight companions, landed on the island in 1691 and remained there for over two years. During this period tortoises (of which Leguat states there were three kinds) and turtles were their main sustenance, and the book abounds in details of their gastronomic excellence; the liver especially appears to have been a great delicacy, and the oil and fat served not only for culinary purposes but also as unguents. Some idea of the enormous numbers may be obtained from the statement that one met herds of from two to three thousand, "so that one could take two hundred paces on their backs . . . without setting foot on the ground."

The next reference to the island is contained in a manuscript which is preserved in the Ministry of Marine in Paris and probably dates from about 1730. In this the unknown author, like Leguat, recognizes three species, comments on their great abundance and size, and waxes eloquent over their excellence

as food. By 1737 the supply of tortoises on the neighbouring island of Mauritius was apparently becoming exhausted, for we find Mahé de la Bourdonnais commencing an import trade from Rodriguez which afterwards assumed huge dimensions. Between 1759 and 1761 no fewer than four vessels were engaged solely in this trade, and the figures available make it evident that in a period of little more than eighteen months at least 30,000 tortoises were taken from Rodriguez. In the latter year the Abbé Pingré, a French astronomer, landed on the island to observe the transit of Venus, and from his diary it is clear that, though still numerous, the tortoises were not as plentiful as formerly; it had then become necessary to send parties,



GIANT TORTOISE (*Testudo rosmaeri*).

Cast of specimen in Natural History Museum of Paris.

Extreme length 5 feet.

carrying two days' provisions, into the interior of the island to collect them and to erect a corral for the retention of those awaiting shipment. From this date onwards little more can be gathered; apparently by 1770 the animals had become so scarce that the trading station erected on the island was abandoned as unprofitable, and though bones were collected in 1832 no mention of the living animals is made by the collectors. Thus in little more than a century these creatures, once so abundant, had completely disappeared, leaving only an indistinct memory, for at that time it was not known with certainty how many species had formerly existed or what had been the characters of each.

Since that time it has been possible, from remains collected

on the island and from a few specimens which in earlier days had found their way to Europe as curiosities, to recognize with some degree of certainty two species, *Testudo vosmaeri* and *Testudo peltastes*, but the specimen in the Paris Museum is the only complete example known. What the third species may have been, for two independent authors recognized three, is still conjectural, but among the many drawings left by the explorer Commerson, who was resident in Mauritius from 1768 to 1773, are four which are labelled as those of the land tortoise of Rodriguez. As Commerson's other figures appear thoroughly reliable it has been thought that, though he never actually visited Rodriguez, he may have drawn a specimen imported from that island and that his figures, which cannot be identified with either of the other species, actually represent the unknown one; Vaillant has accordingly named this hypothetical species *Testudo commersoni*.

On the other islands of the Indian Ocean which formerly supported Giant Tortoises similar conditions reigned, though in the Seychelle Islands the extermination of the indigenous tortoises did not proceed quite so rapidly. Nevertheless, thanks to a gift by Mr. James Hornell, we now know that one island was denuded of its tortoises at a very early date indeed. Mr. Hornell's gift consists of four tortoise eggs (three complete and one fragmentary) found in a sub-fossil state in the guano deposits of Denis Island. The eggs are roughly spherical with a calcareous shell and vary in diameter from about $2\frac{1}{4}$ to $2\frac{1}{2}$ inches; that they are those of a Giant Tortoise there can be little doubt, for their calcareous nature indicates a land tortoise and not a marine turtle, and their size precludes any possibility of their having been laid by any tortoise other than one of the "Giant" category.

The earliest full account of the Seychelles is contained in a manuscript memoir by Monsieur Malavois, who carried out an official inspection of the islands in 1786 and 1787; in this document a full account is given of each island and its resources, and, though sixteen islands are mentioned as possessing Giant Tortoises, Denis Island is not among their number. It is thus clear that Denis Island once supported a Giant Tortoise but that it became extinct before 1787; the discovery of further fossil remains alone can settle the problem of whether it belonged to one of the three species known to have occurred on other islands of the Seychelles, or whether another species ought to be added to the already long list of those exterminated during the eighteenth and nineteenth centuries.

AN INTERESTING BOTANICAL WOOD-CUT.

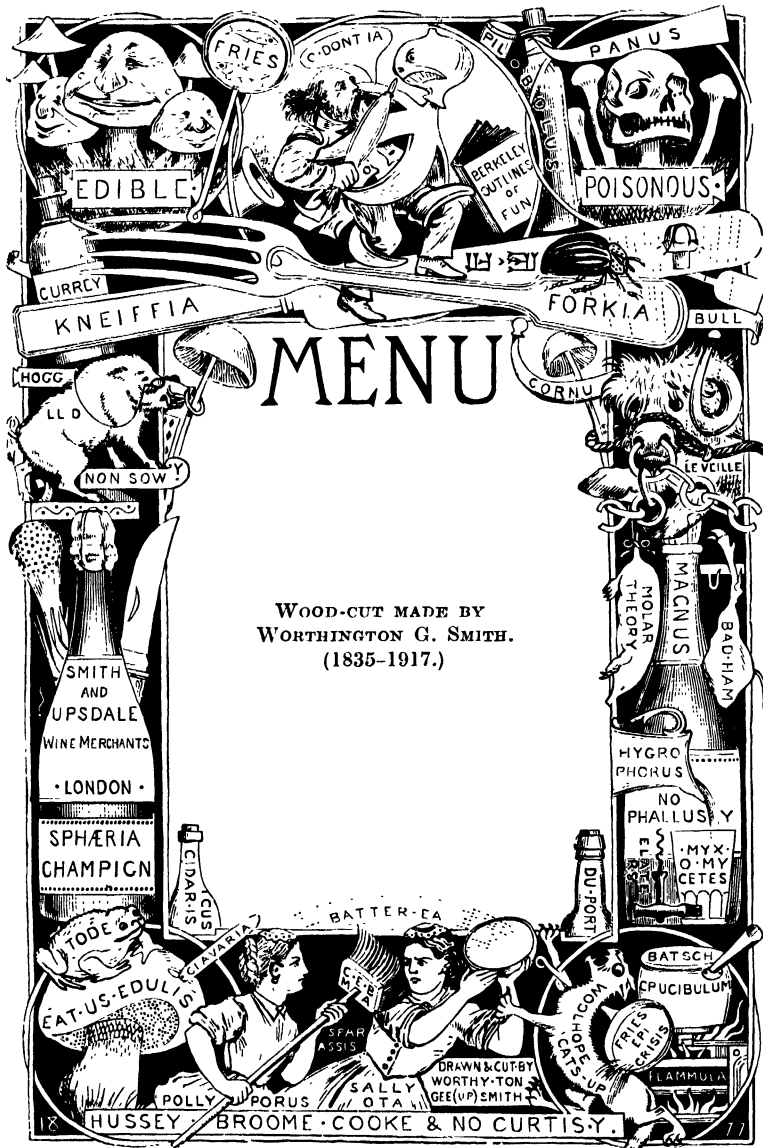
By J. RAMSBOTTOM, M.A., O.B.E., Deputy Keeper,
Department of Botany.

THERE is a wood-cut in the Department of Botany which is interesting from several points of view. It is the work of Worthington George Smith (1835–1917), well known as a botanical artist and engraver and also as a mycologist. He prepared the drawings of the larger fungi now on the stands in the public gallery of the Department, and wrote the “Synopsis of the British Basidiomycetes,” published by the Trustees.

The wood-cut was prepared for a menu card for the dinner of the fungus-foray of the Woolhope Naturalists’ Field Club in 1877, and was reproduced in the *Gardeners’ Chronicle* and in *Punch*. It was also used for a menu card for a dinner given to overseas mycologists by the British Mycological Society on the occasion of the Imperial Botanical Conference in 1924, and again for the 75th Anniversary of the Woolhope Club in 1926, when they entertained the British Mycological Society at Hereford. The term *foray* was apparently first used for an excursion in search of fungi in connection with the Woolhope Naturalists. These were not the first excursions of this kind, for the Worcester-shire Naturalists’ Club held one in its first year, 1846. The Woolhope meetings began in 1868, when Dr. H. G. Bull circulated invitations for “a Foray among the Fungusses;” they soon became recognized as annual gatherings of all British students of mycology, and usually at least one eminent foreign mycologist was present. Worthington Smith took a prominent part in them, and, indeed, he and Edwin Lees were the two referees at the first meeting.

There is a mid-Victorian flavour about many of the punning references to mycologists and fungi in the illustration. The pleasant appearance of edible species in the top left-hand corner is contrasted with the repulsive appearance of poisonous species in the opposite corner. Dioscorides, who divided fungi into these two classes, commented on the fact that poisonous species were unpleasant in appearance. The criterion seems hardly one to be relied upon, but is no worse than the easy methods of distinguishing between the two kinds annually served up in the newspapers. Most of these methods are relics of the classics and are all worthless, with the possible exception of the one which states that “fungi which grow near serpents’ holes” are poisonous; this I have not yet had an opportunity of testing.

The word "fries" in the frying-pan is a reference to Elias Magnus Fries (1794–1878), the Linnæus of mycology. The



awful apparition in the centre is *Geaster*, one of the *Gasteromycetes*, a fungus which was drawn with a much more attractive face by Seger in 1688, when he bestowed upon it the name *Anthropomorphos*. The victim who is applying *Salus* to its nose

(which "no fungus can withstand") is the Rev. Miles Joseph Berkeley (1803–87), the father of British mycology and the author of "Outlines of Fungology"; in those days he was bearded but later on was clean-shaven.

Poisonous fungi *Panus* and a pill or bolus (*Pilobolus*) are then required. *Kneiffia* is a fungal genus—"the cuneiform inscription indicates the character of the fungoid octopus and the Colorado beetle at Hereford"; *Forkia* was considered as soon to be established but has not yet been perpetrated. Frederick Currey (1819–81) was a prominent mycologist who translated Hofmeister's works and was Botanical Secretary of the Linnean Society. Dr. Robert Hogg (1818–97) was more pomologist than mycologist, though a constant attender at the forays; he was the technical editor of the Herefordshire Pomona. Sowy. is James Sowerby (1757–1822), the botanical artist. His original drawings both of English Botany and of English Fungi are in the Department of Botany, and the fungus models in the Exhibition Gallery were prepared by him in order to teach his neighbours the distinguishing characters of edible and poisonous species.

The umbrella and knife were the constant accompaniments of Dr. Charles Bagge Plowright (1849–1910), well known for his book on rusts. W. G. Smith's name appears on the wine-bottle. As he said, "The wine-bottle bears the name of the renowned wine merchants of Rood Lane, who supply so many fungus-eaters with their (as pronounced after dinner) *Sphaeria* champign." *Sphaeria* is a generic name, the other is obviously shortened from champignon.

Heinrich Julius Tode (1733–97) is one of the best known pre-Friesian mycologists and the author of "Fungi Mecklenbergenses." His stool is *Boletus edulis*, the bottle alongside is of the local Hereford product and labelled *Agaricus cidaris*, and is matched in the opposite corner with a bottle of Du Port; Canon Du Port (1832–99) was one of the numerous clergymen who were to the fore in field mycology at that time.

The right-hand side shows the names of Dr. Henry Graves Bull (1818–85), who was the moving spirit of the Woolhope; Maxime Cornu (1843–1901), a leading French mycologist, and his fellow-countryman, Joseph Henri Leveille (1797–1870). The molar theory, represented as very dead, was that propounded by Edwin Lees to account for the formation of fairy rings; he held that the bare zone, traditionally attributed to the pattering of fairy feet, was due to the underground gyrations of moles.

Paul Wilhelm Magnus (1844–1914), a German mycologist,

who was, I believe, a Jew, is shown near Badham—Dr. Charles Badham (1806–57), author of “*Esculent Funguses of England.*” *Hygrophorus* (the water-bearer) is a fungal genus; *Phallus* is also a generic name, and in conjunction with the special type of elater and Myxomycete indicates that water was not likely to be the sole constituent of the liquid refreshment at the dinner. Batsch is August Johann Georg Carl Batsch (1761–1802), author of “*Elenchus Fungorum.*” *Crucibulum* and *Flammula*, fungal genera, need no comment. The accident to the Woolhope ketchup, a recipe of repute, is indicated by reference to one of the classical works of Elias Fries, the “*Epicrisis Systematis Mycologii.*”

The strife depicted below is a jumble of generic and personal names. The first are *Clavaria*, *Battarea* (Batter-ca), *Sparassis*, *Polyporus* (Polly Porus) and *Psalliota* (Sally Ota). The others are Mrs. T. J. Hussey, author of the luxurious “*Illustrations of British Mycology,*” Mordecai Cubitt Cooke (1825–1914), one of the best known British mycologists, Christopher Edmund Broome (1812–86), who was an authority on truffles and usually worked with Berkeley, and Moses Ashley Curtis, an American who also collaborated with Berkeley.

Perhaps the worst joke is the “Drawn and cut by Worthy Ton Gee (up) Smith.”

PORTRAITS AND MEMORIALS OF ROBERT BROWN OF THE BRITISH MUSEUM.

By J. ARDAGH, Clerk, Department of Botany.

It has been found necessary in catalogues of large libraries to distinguish the Robert Brown (1773–1858) of the British Museum, as there were at least five other botanists with the same name : (1) Robert Brown of Perth (1767–1845), (2) Robert Brown of Christchurch, New Zealand (1824–1906), (3) Robert Brown of Liverpool (1839–1901), (4) Robert Brown of Campster (1842–1895), and (5) Robert N. Brown (? –1862). It is remarkable that no portraits or memorials of Brown are mentioned in the inadequate sketch of his life in the “*Dictionary of National Biography*” (*Journ. Bot.*, 1888, p. 285).

Robert Brown, the first Keeper of the Department of Botany, died in 1858. His own herbarium, botanical manuscripts,



Robert Brown

ROBERT BROWN (1773-1858) OF THE BRITISH MUSEUM.
(From a lithograph print in the Department of Botany).

correspondence, diaries, portable dissecting microscope and other objects of interest are preserved in the Department. The Linnean Society has several personal relics, including his watch, chain, and seal (originally Dryander's), lenses and eye-glasses (*Proc. Linn. Soc.*, 1887-8, p. 110), a dissecting microscope (*loc. cit.*, 1923, p. 9), and his father's cane. A microscope used by Brown is exhibited in the Herbarium at Kew Gardens.

In a niche on the outside wall of his birthplace, at the corner of High Street and Bridge Street, Montrose, stood a bronze bust, by D. W. Stevenson of Edinburgh, which was presented to the town and unveiled by his kinswoman, Miss Hope Paton, on October 18, 1895 (*Journ. Bot.*, 1895, p. 352; 1896, p. 26). A marble replica of this was unveiled by Prof. W. H. Trail on February 18, 1901, in the Picture Gallery of Marischal College, Aberdeen, where Brown was a student. According to the Town Clerk of Montrose, Brown's birthplace has been demolished, the bust being now in the Public Library. A water-colour of the birthplace is at the Linnean Society, which possesses also a portrait in oils by H. W. Pickersgill (1835), and a marble bust by Peter Slater (1859), presented by subscribers on November 7, 1861 (*Proc. Linn. Soc.*, 1861, pp. liii-liv). The former has been engraved in line by Charles H. Fox (published May 24, 1837) and copies may be seen in various institutions. A replica formerly in possession of Miss Paton (*Sunningside Chronicle*, March 1888) has been on loan at the National Gallery, Edinburgh, since 1901: it shows slight variations from the portrait above mentioned. The figure of Brown in the group representing "Eminent Men of Science living in the year 1807-8," now in the National Portrait Gallery, is evidently founded on the Pickersgill painting; the group was painted in the years 1855-8, the figures being drawn by J. F. Skill, grouped by Sir John Gilbert, R.A., and finished by Wm. Walker and his wife Elizabeth, who spent several years collecting the best portraits. It was engraved, with several alterations, by Wm. Walker and G. Zabel, and published by Walker & Son, June 4, 1862. There are plaster casts of the marble bust in the Department of Botany, and the Museum of the Royal Botanic Gardens, Sydney, purchased 1899 (Maiden, "Sir Joseph Banks," p. 122), and a reduced copy in plaster at the Royal Botanic Gardens, Kew, presented by Dr. Bowerbank in 1873 (Milner, "Kew Portraits," p. 20).

Kew has also a portrait in oils by Stephen Pearce (*circ.* 1856), painted for Lady Franklin, afterwards in the collection of Sir J. D. Hooker, and presented to Kew by the Bentham Trustees

(*Kew Bull.*, 1898 p. 25); and a medallion modelled in wax by R. C. Lucas (1852), another example of which has recently been presented to the Department of Botany by Col. E. C. Freeman. In the British Museum there is also a portrait in oils by an unrecorded artist, a lithographic portrait (*v. p. 159*, perhaps privately issued by Brown), and a lithographic portrait by J. H. Maguire (Ipswich Series, 1850). Only one photograph appears to have been taken of him (by Maull and Polyblank); a copy of this is at the Linnean Society, and it is reproduced in the *Illustrated London News*, July 10, 1858, p. 29, and as a frontispiece to "An Introduction to the Study of South Australian Orchids" (R. S. Rogers), ed. 2 (1911).

Messrs. Maull and Polyblank made a speciality of the portraiture of scientific men, and in this connection it may be interesting to reproduce a copy of a letter from Brown to Baron F. H. A. von Humboldt, asking the Baron to favour Mr. Polyblank with a sitting. The copy, which is in the Department of Botany, is as follows :—

To His Excellency
Baron A. de Humboldt.

My Illustrious and very dear Friend,

I am so ready to embrace any occasion which will bring myself to your kind recollection that I am not unlikely sometimes to be guilty of indiscretion.

This Note will be delivered to you by Mr. Polyblank, a distinguished Photographer, who has for some time been engaged in taking Portraits of Scientific Men mostly Members of the Linnean Club, and who as well as the Members of that Club is extremely desirous of prefixing yours to that extensive series.

To obtain your kind permission to sit to Him for your Photographic Portrait is his only object in visiting Berlin, and having applied to me for a Letter of introduction I have, I fear, indiscreetly written this Note, which I should not have done had I supposed that the Operation required many minutes of your time.

I am happy to hear from several quarters recent and very favourable accounts of your Health, which I should be most happy to have confirmed by yourself.

As to myself now far advanced in my 84th Year, I am still on my Legs, in tolerable health and doing my duty in the British Museum, not however without infirmities and

beginning to lose my Memory of recent events, but am still in comfortable possession of sight & Hearing.

That you may continue to enjoy your present state of health is the earnest prayer of,

Dear Baron Humboldt,
your attached and deeply
indebted Friend,

ROBERT BROWN.

17 Dean Street, Soho,
Oct. 20/57.

Brown died on June 10, 1858, at his house in Soho, where a commemorative tablet was erected by Dr. Boott (*Journ. Bot.*, 1863, p. 32); a water-colour of the house is at the Linnean Society. "On the 15th of June his remains were consigned to the earth, surrounded by Australian flowers, at Kensal Green Cemetery" (*Ann. and Mag. Nat. Hist.*, 1859, iii, p. 331). His grave (No. 14583, 50 square, Road Side) is marked by a granite ledger stone, with an inscription that will soon be illegible:—

"Sacred / to the memory of / Robert Brown Esq., D.C.L., F.R.S., &c. / Keeper of the Botanical Collections / in the British Museum, / Foreign Associate of the Academy / of Sciences of the Institute of France / and formerly President / of the Linnean Society of London. / He was born / at Montrose in Scotland / on the 21st of December 1773, / and died / on the 10th of June 1858 / in the 85th year of his age / at his residence / 17 Dean Street, Soho, / in the apartments which had been / for nearly half a century / the resort of all who were / distinguished in science / during the Presidency of the Royal Society of his friend and patron / Sir Joseph Banks."

The author is indebted to Mr. S. A. Skan (of Kew) and Mr. S. Savage (of the Linnean Society) for help in the compilation of these notes.

PERSIAN TIGER AND SOUTH AFRICAN LEOPARD.

By J. G. DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

RECENT additions to the exhibition collection include fine examples of the Persian tiger and South African leopard, both mounted in the Rowland Ward Studios.

The Persian race of tiger (*Felis tigris virgata*) is rather smaller



PERSIAN TIGER.

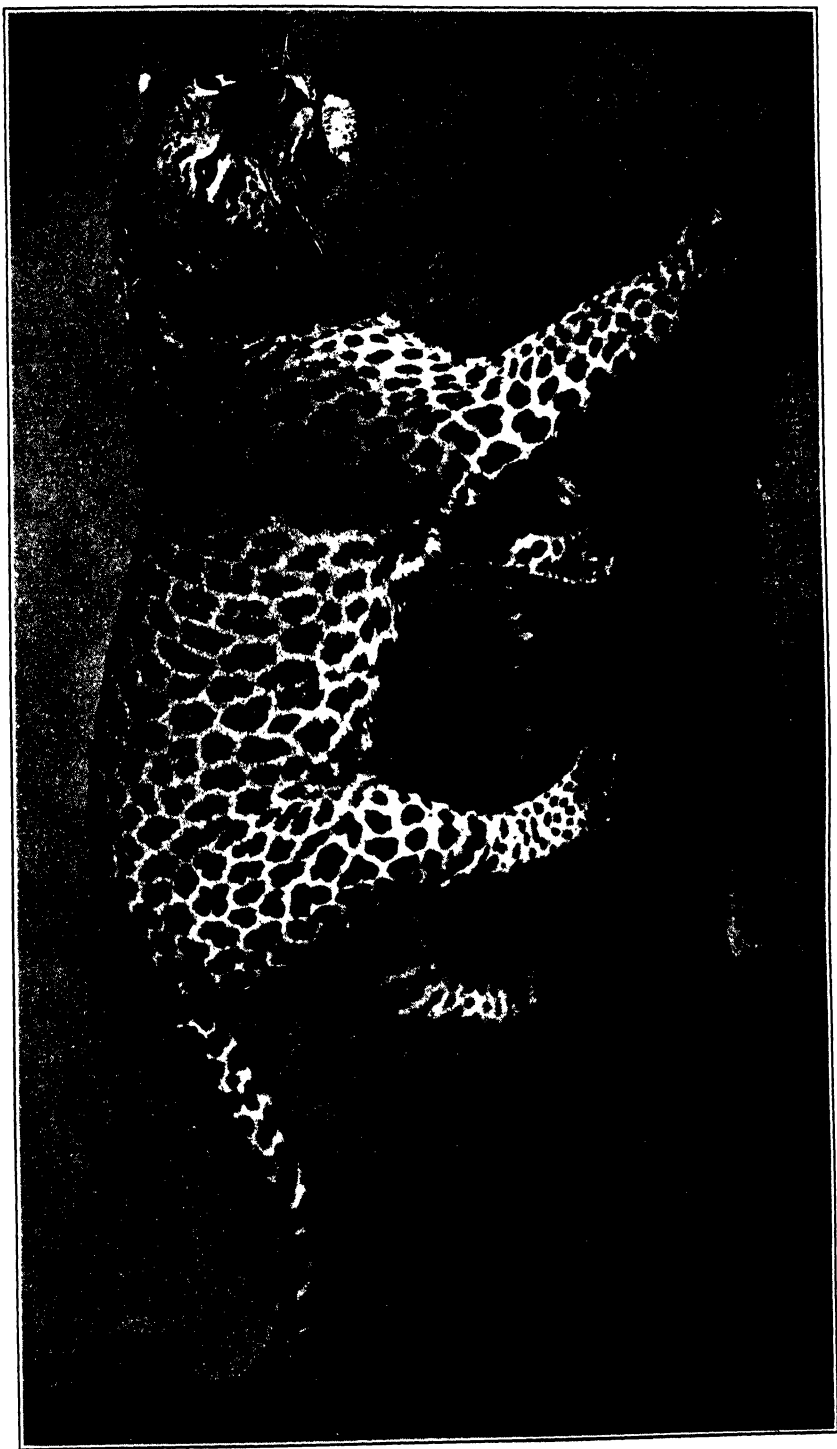
than the Indian tiger and more roughly haired, though not as long-coated as the Manchurian, or Siberian tiger (*Felis tigris longipilis*). The Persian race is found in the Caspian Provinces of Persia and the Caucasus, and is in some ways intermediate between the typical Bengal tiger and the Manchurian form, although both the Bengal and Manchurian tigers are larger animals. Smaller tigers are met with in the East Indies, both the Javan tiger (*Felis tigris sondaica*) and the Bali tiger (*Felis tigris balica*) being smaller than the Persian race.

The tiger has a wide geographical distribution, extending from the Caucasus through northern Persia, India, Assam, Burma, and along the Malay Peninsula to the Malay Islands; in the north it is met with in China and spreads as far as Manchuria, Amurland, and Korea. It is not found in Ceylon, the Palk Strait being apparently beyond the swimming powers of the animal; this fact further indicates that the tiger must be a comparatively recent immigrant from the north or east into India itself, as there is evidence to prove that Ceylon was connected with the Peninsula at no very remote period.

In India tigers are found all over the Peninsula south of the Himalayas, and in the latter mountains up to a height of 7000 feet. The Manchurian tiger, however, which ranges into Korea, is the one most suited to stand the extreme cold, the length and thickness of the fur being quite remarkable. The Persian name for the tiger is "Babr," and in Hindustani the tiger is known as "Bagh" and the tigress as "Baghni."

The South African leopard is an especially fine specimen from the Sabi River in the Transvaal, and is now exhibited in the Lower Mammal Gallery.

The leopard, or panther, is the only large spotted cat in the Old World; the single species, including a number of local races, is widely distributed over Africa and a great part of Asia. A large number of subspecies, or geographical races, have been founded on African material, but they are doubtfully distinguishable, with the exception of the Somali leopard, which appears to be a distinct pigmy form (the length of the flat skin rarely exceeding 6 ft.), much paler than the South African and other African races, the general body colour being pale creamy buff instead of yellowish. Possibly it represents a distinct species, but at present it is considered as a small race of *Felis pardus*. The West African leopards are usually richer in colour than the South African type, and in Abyssinia there occurs a very heavily spotted animal, sometimes almost black in colour. The skins of the latter, which come from the highlands of



SOUTH AFRICAN LEOPARD.

In the exhibition case Lycidæ from different parts of the world, Brazil, Mexico, Burma and South Africa, are shown, and opposite them are placed other insects of many different groups associating with them, all remarkable for the fact that their superficial appearance and coloration are those, not of their own relatives, but of the particular Lycid species with which they are accustomed to congregate.

In preparing the set of illustrative specimens for exhibition it was found that, although the offensive insects mimicked were

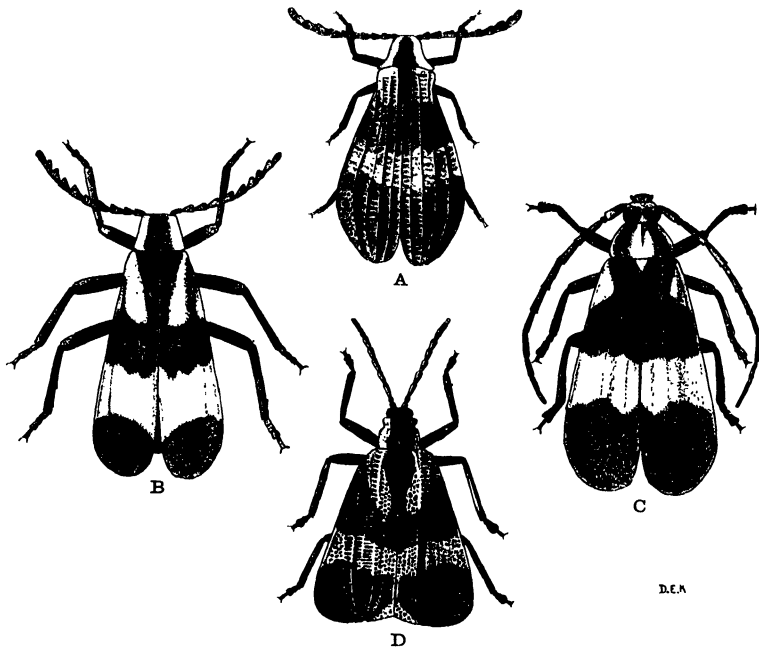


FIG. 1.

A. Lycid Beetle (*Calopteron*, mimicked). B. Mimetic Telephorid Beetle (*Daiphron*). C. Mimetic Cerambycid Beetle (*Deltosoma*). D. Mimetic Hispid Beetle (*Cephalodonta*).

generally common enough, it was impossible in many cases to find a specimen of the mimic to exhibit. Of several only a single example is known. This is no doubt due, not to their rarity, but to their success in eluding capture by concealing themselves amongst a crowd of insects of another kind from which they are almost indistinguishable. It has sometimes been necessary, therefore, to substitute a drawing for an actual specimen.

The first illustration (Fig. 1) represents such a case as that just described, the specimens having been found all together by a traveller in Ecuador. At A is seen the unpalatable Lycid (*Calop-*

teron), with its characteristic dilated form and vividly contrasted colouring of black and orange. C is a Cerambycid (*Deltosoma*), quite different structurally, but with the same pattern of black and orange, and flat expanded shape, both quite uncharacteristic of this family. B is a species of *Daiphron*, of another family, the Telephoridæ, in which the same striking pattern and peculiar shape again appear, and D (*Cephalodonta*) belongs to a fourth family, the Hispidæ, but distantly related to all the others. It is a feature of the Lycidæ that the wing-covers, instead of exactly meeting along the middle of the back, as in nearly all

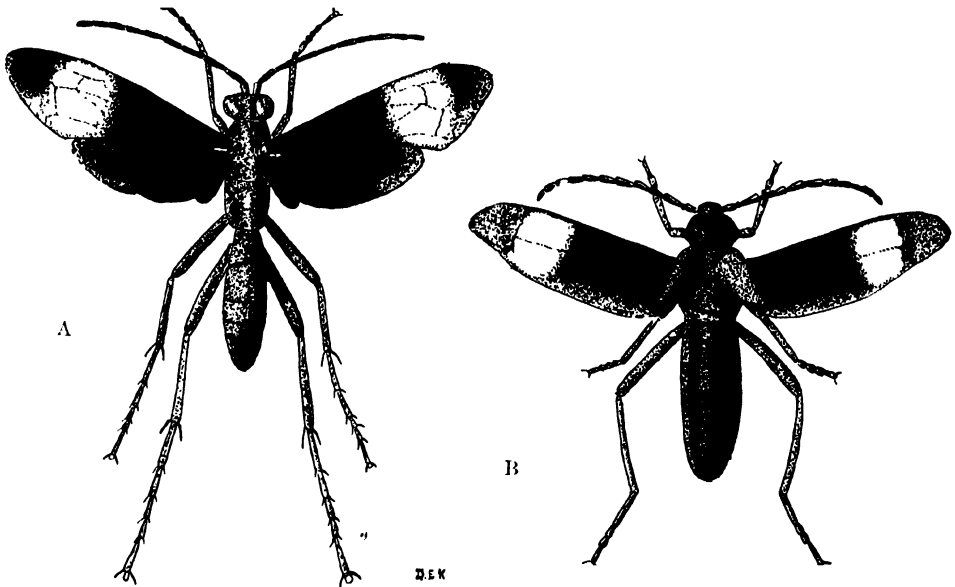


FIG. 2.

A. Wasp (*Mygymia aviculus*). B. Mimetic beetle (*Nothopeus fasciatipennis*).

other beetles, are separated and rounded off behind. This peculiarity is reproduced by the mimics B and C, but not by D, in which the wing-covers, as usual, exactly meet and are straight-edged behind. It is very interesting to observe, however, that the appearance of separation is produced by the pale colour of the transverse band being continued backwards along the inner margins and rounding off the sharp angles. This curious species, called *Cephalodonta lycoides* from its Lycid-like aspect, is one of those of which only a single specimen is known to exist in European collections.

The plastic character of the Cerambycidæ, in contrast with the uniformity of the Lycidæ, will be realised on comparing C in

the first illustration with B in the next (Fig. 2). The latter is a defenceless Cerambycid (*Nothopeus*) found flying in Borneo in company with the formidable wasp *Mygymia* (A), by a naturalist, Mr. W. B. Pryer. Although not uncommon in Borneo, there is, I believe, only a single representative of the mimic in this country and it has not been possible to exhibit it in the Museum. In the Cerambycid *Deltosoma*, the wing-covers have become dilated to simulate the appearance of a Lycid; in *Nothopeus*, on the contrary, they are so much shrunk as no longer to serve any purpose, and the membranous wings, which in nearly all beetles are completely hidden except when being used in flight, are exposed like those of the wasp. It is still more

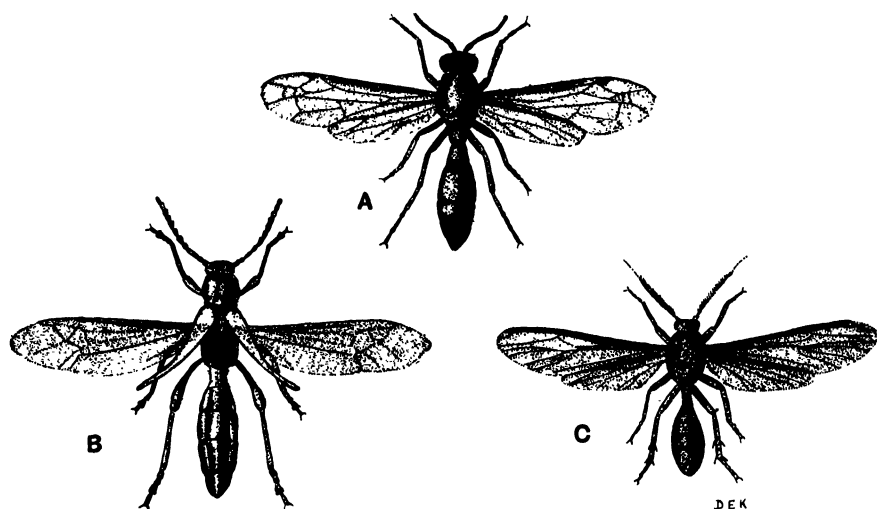


FIG. 3.

A. Wasp (*Polybia*). B. Mimetic Beetle (*Acyphoderes*). C. Mimetic Moth (*Pseudosphex*).

remarkable that, instead of being quite transparent, as in other beetles, they have assumed the dark colour of the wasp's wings, with large white patches exactly imitating those in the model, although the latter has two pairs of wings, of which the first pair bears the white spots, whereas the single pair of the beetle corresponds to the hind wings. Mr. Pryer has recorded that in flight, or at rest a couple of yards away, the two insects are quite indistinguishable.

The beetle just described has not acquired the wasp-waist of its model, although seen sideways the body has a similar curvature, but there are other Cerambycids in which this feature has been developed. For example, the Brazilian species of *Acyphoderes* exhibited (see B in Fig. 3), an insect of smaller

size than *Nothopeus*, mimics a wasp, A (*Polybia*), of the same size as itself, and has not only the very un-beetle-like waist of its model, but also the sharp-pointed tip of the body which suggests the non-existent sting. In this beetle the wing-cases are not extremely abbreviated, as in the *Nothopeus*, but are reduced to very thin strips curving outwards in such a way that, being yellow and translucent, they appear to add to the width of the wings and increase their resemblance to the four united wings of the wasp. Another specimen which must not be overlooked is a moth (*Pseudosphex*) shown in the same group (Fig. 3, C). This also mimics the same wasp, and has acquired the wasp waist and translucent wings.

Following the last group is another, also from Brazil, which is perhaps the most astonishing of all. The model in this case is a parasitic wasp, *Ipobracon subfasciatus*, a black insect with four nearly black wings, the front ones decorated near the middle of the front edge with a bright yellow mark of a peculiar shape. Associated with this insect is a black Cerambycid, *Isthmiade braconides*, with wasp-like waist and sharp-pointed tail, and with the wing-covers reduced, as in *Acyphoderes*, to thin vestiges. But most remarkable is the exact imitation of the wings of its model. The wings of beetles are almost invariably translucent and uniform, without markings of any kind, but this mimic has not only nearly black wings like the *Ipobracon*, but in precisely the corresponding situation appears a bright yellow mark of exactly the same peculiar shape. Moreover, the single pair of wings of the beetle, which, as mentioned before, are really its hind wings, has the identical shape produced by the two pairs of the model.

It would scarcely be possible to find amongst insects a greater contrast than is presented when we pass from these wasp-mimics to those that follow them, and yet the latter belong to the same family and anatomically differ hardly at all. Their models are unpalatable beetles of other families and advertise their unpalatability by warning colours of rich scarlet and black. Their wing-cases are dilated and of curious shapes, to produce the maximum degree of conspicuousness. Colour, pattern and curious outline are all imitated, in the first case by one species, and in the second by two different species of Cerambycidae, the complicated pattern of the second model being faithfully reproduced by each of the two mimetic species.

In the last instance of all the model (*Amphix subcordatus*) belongs to another and entirely different family of distasteful insects (Endomychidae), and has a very different, almost

hemispherical, shape, while the mimic (*Cyclopeplus batesi*) has not only acquired the same shape and colour, but shows a remarkable imitation of a small but characteristic detail in the antennæ (feelers) of its pattern. These are of only moderate length, and end in a racket-shaped flat black knob. The imitator has very long antennæ (a feature of its family implied by the name Longicorn), but at a point corresponding with the broad termination in the model there is an abrupt fringe of black hairs, which arrest the eye and deceive it into supposing that the organs end in a knob, like those of the insect mimicked.

The term Mimicry has sometimes been objected to on the ground that it suggests conscious imitation on the part of the creatures to which it is applied, but, provided it is clearly understood that the mimicry is on the part of species and not of individuals, it is exact and expressive and no better term is likely to be found. Mimicry is, of course, a phase of Protective Resemblance essentially the same as that by which desert animals have acquired a sandy hue and those of polar regions have become white, by which a bird upon its nest harmonises with its environment or a butterfly resting with folded wings looks like a dead leaf; and the result has no doubt been brought about in all cases by a similar process. Adaptation of insects of different groups to a similar mode of life is likely to produce a certain degree of similarity, which may be more a matter of similar behaviour than anything else. Amongst a crowd of offensive insects a few others not unlike them will have at least a chance of being passed over by their enemies, and those in which the resemblance is closest will have the best chance of surviving and producing the next generation. As breeders, by selecting in every generation the slight variations which please them, "improve" breeds of rabbits, dogs or sheep, Nature can "improve" an advantageous resemblance by the selective agency of predaceous animals. The process has not reached the same stage in all cases, but, having begun, it continues through long ages, and its finished or nearly finished results cannot fail to excite the admiration of those who study them.

BOOK NOTICES.

The Guests of British Ants, their Habits and Life-histories. By H. St. J. K. DONISTHORPE, F.Z.S., F.E.S. Pp. xiii + 224, with 16 plates and 55 figures. 1927. (London: George Routledge & Sons, Ltd. 18s.)

BRITISH entomologists are to be congratulated upon the publication of a book which will provide a starting-point for all who wish to pursue inquiry

into one of the most fascinating subjects of investigation open to the field naturalist. The mysterious life of the Ant communities and their many and various inmates is a subject upon which, in spite of an already voluminous literature, exact knowledge is as yet only at its beginning. Mr. Donisthorpe enumerates several hundred species of insects and other creatures haunting the nests of British Ants, 146 of them having been added to the list by himself.

The number of insect species to be found amongst the Ant communities of the world is enormous. More than a thousand kinds of Beetles alone have been described, and this is only a fraction of those actually occurring there. Every degree of adaptation to the peculiar mode of life entailed is found amongst these creatures. Some, whose association with the Ants is probably of comparatively recent date, have yet undergone little bodily change and are still capable of leading an independent life, whereas others, amongst which are some of the strangest living things known to us, have acquired the profoundest modifications of structure in adaptation to their strange method of existence, showing in a most striking way how much more ancient is the communal life amongst insects than in mankind.

The author has confined himself to a bare record of the observed facts and avoided all the psychological and sociological implications of those facts which render the subject of such peculiar interest to ourselves, enabling us to study in miniature, and work out to extreme limits processes which are only incipient in human societies. If the sluggard may profitably go to the Ant for an example, there are certainly many respects in which it is advisable to consider her ways only in order to avoid them. The attraction for Ants of the pleasant liquids produced by many of the alien inmates of their nests has been compared to alcoholism in our own species. It often leads to more solicitude being shown for the intruders than for the brood of the Ants themselves, upon which in many cases the pampered guests are actually allowed to prey. It will no doubt surprise many readers to learn that amongst such murderous inmates of these strangely-ordered households are the caterpillars of the "Large Blue" butterfly, which, for the sake of a sweet secretion exuded by the caterpillar from a special gland, is sought out by the Ants and carried into their nest, where it passes the winter in security and luxury, fattening upon the young of its hosts. Excellent figures of this remarkable caterpillar are included amongst the numerous illustrations contained in the book, which is also well indexed and has a useful bibliography of the English literature upon its subject.

The Beaver: its Work and its Ways. By EDWARD ROYAL WARREN, S.B. Pp. xv + 177, with frontispiece and 78 figures. Monographs of the American Society of Mammalogists, No. 2. (London: Baillière, Tindall & Cox; Baltimore: The Williams and Wilkins Company. 13s. 6d.)

SEVERAL books have been written about the beaver, notably Morgan's "The American Beaver and His Work," but no work has hitherto dealt with the subject in such a comprehensive manner as Mr. Warren does in this little volume, which is full of good material and illustrations.

The author commences with a general description of his subject, comparing it with the better-known types of extinct beavers and the Giant Beaver (*Castoroides*), which probably attained a length of 8 or 9 feet and possessed incisor teeth measuring from 8 to 9½ inches in length; these Giant Beavers were confined to North America. The beaver that still inhabits certain parts of Europe, and at one time was plentiful in Britain, is a smaller animal, *Castor fiber*, closely related to the American species, *Castor canadensis*.

Probably the beaver had a great deal to do with the formation of our Fen districts, owing to the blocking of the natural drainage by dams and fallen tree-trunks; and the formation of the peat mosses of Lancashire appear to be due to this once common British mammal. Barrett-Hamilton and Hinton ("A History of British Mammals") doubt "whether a small island like Britain could have long continued to support a large population of beavers"; had there been no human interference, however, it seems more than probable that an animal which had existed for so many centuries—it did not become extinct until the thirteenth century—would be still living in some of our rivers and lakes. This view is to a certain extent supported by the greatly restricted distribution of the species in Europe at the present day. Although a common animal in Great Britain, it was never an inhabitant of Ireland.

The chapter on "Intelligence" is of special interest; the author, after comparing the work of a beaver with that of an engineer, remarks "that each adapts himself to circumstances, and if in the case of the man this shows intelligence, why not also in the case of the beaver?" This was the view of G. J. Romanes, who expressed the opinion that "there is no animal, not even excepting the ants and bees, whose instinct has risen to a higher level of far-reaching adaptation to certain conditions of environment, or whose faculties, undoubtedly instinctive, are more puzzlingly wrought up with faculties no less undoubtedly intelligent."

Chapter IV deals with the dam, and contains some very instructive photographs of the beaver's work. It is sometimes held that these dams are commenced by large trees being felled across a stream; this is regarded here as exceedingly doubtful, the dams being constructed largely of branches of willows, alders, or whatever brushwood is most available, covered with mud and stones. Further layers of brushwood are placed upon the first, each in turn weighed down with mud and gravel, until the dam reaches the desired height. Dams are sometimes constructed of sods of earth, and one instance is given of coal being made use of for this purpose. Beaver dams vary greatly in size, from a few feet to many yards in length; one case is mentioned of a dam 2140 feet long, no doubt the work of many generations. Dams are usually under 5 feet in height, though records of 8 feet 8 inches and 11 feet 1 inch are noted. The dam building is always carried out in the autumn in preparation for the coming winter. The dams are, as a rule, built in running streams, but occasionally they are constructed at the outlets of ponds in order to raise the water level.

It is reported that at times beavers will drain their ponds by opening the dams, closing them up again afterwards. It has been suggested that this is done for sanitary reasons. Beaver dams are frequently of great use to agriculture, in keeping a supply of water available for irrigation purposes. It is recorded that in the year 1924, after a protracted drought, the water supply for the Minnesota reservoir gave out, and fourteen large beaver-ponds just above the Minnesota canal were tapped, with the result that for each dam destroyed a little over 1,000 dollars' worth of fruit was saved. The views of the beavers on this question of their utility are not given.

A certain amount of damage is done to timber through flooding caused by dams, and damage also may be caused by cutting down trees or girdling them, though this is said to be very little compared with that caused by flooding.

The chapter devoted to the beaver's house, or "lodge," contains much that is of interest, including diagrams of various types of lodges; one of these shows a lodge measuring 30 feet in diameter and $8\frac{1}{2}$ feet in height, and having no fewer than ten entrances. The lodge is usually built of brushwood and mud, and the entrances open under water, deep enough down to prevent freezing. There is, as a general rule, one central chamber to each lodge; the

old idea of a many-roomed establishment is here treated as an instance where fiction had precedence over fact. On p. 130 a charming photograph is given of two young beavers inside the central chamber of one of these lodges.

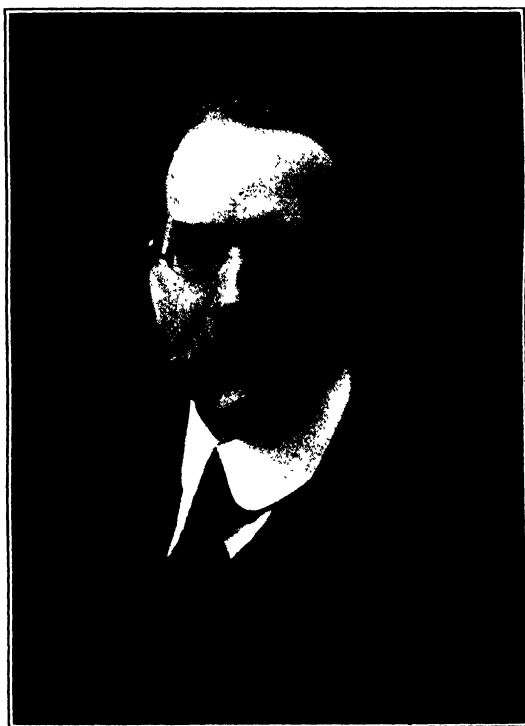
The volume concludes with a chapter on beaver fur and one dealing with things a beaver does not do, in which we learn that, intelligent as this animal appears to be, it does not use its tail as a trowel or as a sledge to carry mud on.

The author is to be congratulated on the production of a most useful and instructive work; it is to be hoped that something similar will be written about some of our own interesting mammals, such as the Badger or Mole, as this type of book is entertaining to the general reader and of great interest to the scientific observer.

STAFF NEWS.

DR. G. T. PRIOR, M.A., D.Sc., F.R.S., Keeper of Mineralogy, retired from the service of the Trustees on December 16 after just over forty years of service.

George Thurland Prior, who was born on December 16, 1862, was educated at Christ Church Cathedral School and Magdalen College School, and at Magdalen College, Oxford, where he held a demyship in natural science. He obtained second-class honours in Mathematical Moderations in 1883, and first-class honours in Natural Science (Chemistry) in 1885 and in Natural Science (Physics) in 1886. He joined the staff of the British Museum as second-class Assistant (old style) in the Department of Mineralogy on January 21, 1887, and succeeded to the Keepership on July 26, 1909, after the post had been vacated by the appointment of the late Sir Lazarus Fletcher as Director. Dr. Prior has long been a recognized authority on chemical mineralogy and on petrology and has shown exceptional manipulative skill in chemical analyses; during recent years he has devoted particular attention to the study of meteorites, and his work has greatly tended to the simplification of their classification. The value of his researches was recognized by the Geological Society of London by



GEORGE THURLAND PRIOR, M.A., D.Sc., F.R.S.,
who recently retired from the Keepership
of Mineralogy.

the bestowal upon him of the Wollaston Fund in 1900 and of the Murchison Medal in 1927. Dr. Prior is President of the Mineralogical Society and was for many years its General Secretary.

* * * * *

Dr. Leonard James Spencer, Sc.D., F.R.S., has been appointed Keeper of Mineralogy in succession to Dr. Prior. Dr. Spencer was educated at Keighley Trade and Grammar School and Bradford Technical College; Royal College of Science, Dublin, where he held a Royal Exhibition and gained the Associateship with a first class in Chemistry; Sidney Sussex College, Cambridge, of which he was a scholar and where he graduated with first-class honours in the Natural Sciences Tripos, Part I in 1892 and Part II in 1893, being awarded the Harkness University Scholarship in Geology. He joined the staff of the Department of Mineralogy as second-class Assistant (old style) on January 1, 1894, and was promoted to a Deputy Keepership on June 14, 1927. He has edited the *Mineralogical Magazine* since 1901. Dr. Spencer was awarded the Wollaston Fund in 1902. He has been elected Honorary Member of the Royal Geographical Society of Cornwall, Honorary Life Fellow of the Mineralogical Society of America, and Ehrenmitglied der Deutschen Mineralogischen Gesellschaft.

The Trustees have further appointed Dr. W. D. Lang, ScD. (*q.v. supra*, p. 64), Keeper of Geology upon the retirement of Dr. F. A. Bather, D.Sc., F.R.S., on February 17, 1928.

* * * * *

The Deputy Keeperships thus vacated have been filled by the promotion of Mr. M. A. C. Hinton and Mr. J. Ramsbottom, M.A., O.B.E., Assistant Keepers in the Departments of Zoology and Botany respectively.

Mr. Martin Alister Campbell Hinton, who has worked at the Museum for many years, joined the staff as Assistant in the Department of Zoology on August 12, 1921, and was placed in charge of the collection of mammals.

Mr. John Ramsbottom was educated at Emmanuel College, Cambridge, where he obtained a first class in Part I of the Natural Sciences Tripos in 1908, and a second class in Part II in 1909. He held a research fellowship at Victoria College, Manchester. He joined the staff as second-class Assistant (old style) in the Department of Botany on July 18, 1910. Mr. Ramsbottom is Botanical Secretary of the Linnean Society and General Secretary and Past-President of the Mycological Society. He served in the Royal Army Medical Corps during the war, and reached the rank of captain; for his services he was appointed an Officer of the Order of the British Empire.

* * * * *

Mr. William Hewett Sanders has been appointed General Foreman in succession to the late Mr. J. J. Parkes.

Natural History Magazine

No. 6

APRIL, 1928

Vol. I

THE SNOW-LEOPARD OR OUNCE.

By J. G. DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

THE Museum has recently acquired a young specimen of the Snow-Leopard (*Felis uncia*), which is now on exhibition in the Lower Mammal Gallery and makes a very attractive addition to the series of large Carnivora. It is mounted in a lying-down



SNOW-LEOPARD OR OUNCE.

position and is a recent production of the Rowland Ward studios.

The Snow-Leopard is the most distinct of all the Leopards, and is a very much commoner and more widely distributed species than it was formerly thought to be. It has at times been mistaken for the long-haired, pale-coloured Persian Leopard, which is a geographical race of the Leopard proper.

The Snow-Leopard, when adult, is about 24 in. high at the

shoulder and sometimes exceeds 7 ft. in length; its tail is proportionately longer than that of the Leopard. It is characterized by the length and thickness of the fur, which is very soft and is in consequence now much used for ornamental purposes; in the general colour of the fur it is very much paler than the Leopard. The spots, except on the head, are larger and less distinct; on the body they have mostly the form of irregular rosettes, with the areas inside rather richer in colour than the general ground colour; on the head and limbs they are solid, without light centres, and the terminal part of the tail is heavily marked with solid black spots, which tend to form rings. The under-parts of the body are white with a few black spots. The skull, which is about 6 or 7 in. in length, is distinguished from that of the Leopard by the more swollen palate and shorter nasal bones.

The Snow-Leopard is found over a vast area of Central Asia, inhabiting the Himalayas and extending into Tibet and Ladak; in the north-west it reaches as far as Gilgit and Nagar, and is also a native of Turkestan, Trans-Baikalia, Amurland, and north-west China. It is essentially a mountain animal, living at elevations of between 6000 and 20,000 ft., and appears to thrive in the snow and intense cold of the higher altitudes.

It preys for the most part on wild sheep, such as the bharal and shapo, and probably the chiru (Tibetan Antelope) and goa gazelle not infrequently fall victims. When the animals take to preying on domesticated flocks and herds, which sometimes happens in the winter months, they are capable of doing considerable damage, as an adult Snow-Leopard can pull down and kill a bullock without difficulty.

In addition to the specimen referred to, the Museum Collection contains some excellent skins and skulls and a mounted adult animal.

INCUBATION AND PARENTAL CARE IN MARINE WORMS.

By C. C. A. MONRO, M.A., Assistant, Department of Zoology.

It is a difficult matter to avoid dramatizing the behaviour of animals when it resembles our own. We are apt to attribute to them all manner of passions, motives, and ideas, such as we ourselves experience, and we anthropomorphize even the

animalcule. There is much to be said for this most human trick of the imagination, for there is no means of looking at the world through the eyes of the turbot; flying the Atlantic may reveal to us a bird's-eye view, but not a sea-gull's mind. This is regrettable, because the conceptions of space and time imposed upon, shall we say a flatworm, by the limitations of its powers of action would provide the mathematical philosophers with much valuable matter.

Although the interpretation of animal behaviour in human terms may lead to much shallow and sentimental thinking, comparable perhaps to the "pathetic fallacy" of the poets, yet the mechanistic view that all animal behaviour is the outcome of reflex responses to mechanical and chemical stimuli, a view which denies to the animal either purpose or power of choice, is equally wide of the mark. It is obvious that the treatment of living things as physico-chemical systems is necessary if the study of animal psychology is to be raised from the merely descriptive and placed on a sound quantitative basis, which can and does yield valuable data, capable of comparison and tabulation; yet there is a danger of truth being sacrificed to method. A clinical thermometer will tell a trained observer much, but it is not a register of a sick man's fantasies. The patience and poetic sympathy of J. H. Fabre led him further towards an understanding of the ways of animals than all the mazes and traps and dinner-bells ever invented by the student.

No aspect of animal behaviour is so apt to be sentimentally treated as parental care. In its sublimated human form of parental love it is, of course, a factor of the greatest importance in the human economy, and the existence of the family as the chief unit of organization in all civilized communities is probably the outward manifestation of this impulse. Furthermore, parental love occupies a unique and sacred niche in the popular imagination. If the American cinematograph is any criterion, the most hardened Chicago thug will burst into tears on the mention of the word "mother-love."

In the animal kingdom the elaboration and perfection of

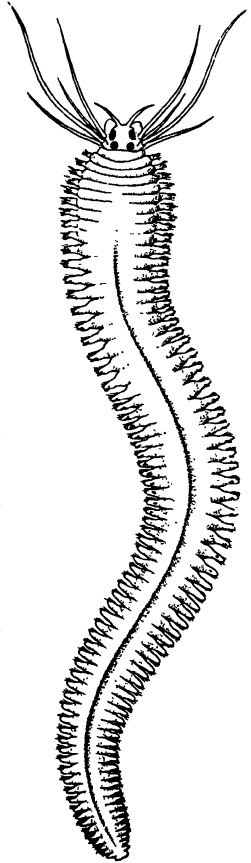


FIG. 1.
Nereis dumerilii.

methods of incubation and parental care do not seem to run parallel with complexity of organization. In the course of evolution morphology has sometimes followed one path, and instinct and physiological mechanism for the preservation of the young another. Thus an astonishing number of different modes of incubation and even signs of parental care are to be found among the marine worms. Professor C. Gravier, of the Paris Natural History Museum, has collected all the available knowledge on this subject up till 1923, the date of the publication of his admirable memoir, which has more recently been

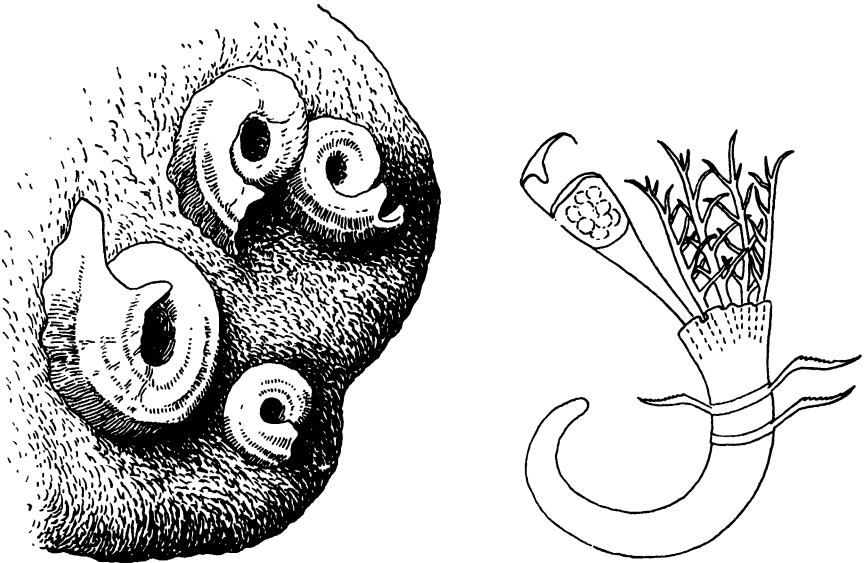


FIG. 2.--TUBES OF *Spirorbis* WITH OUTLINE OF A SPECIMEN.

supplemented by some valuable observations by Professor R. Herpin.

The present article is concerned only with observations made on worms to be found on the Channel coasts of England and France. Professor Herpin frequently found off the coast at Cherbourg two *Nereis caudata*, which are close relatives to the worms used by fishermen as bait for whiting, living together in the same tube. This tube is cylindrical and formed of a transparent membrane strengthened by a thick layer of sand and gravel, except in certain places where the sand is interrupted, and there are windows in the tube by which the occupants can emerge. These couples are invariably male and female and they live side by side in their tube, seldom leaving it, for several weeks. As the time for the liberation of the eggs approaches the female

appears to grow shorter and the eggs accumulate in the middle of the body. The actual discharge of the eggs is probably effected by rupture of the body wall, but possibly by means of the somewhat doubtful ciliated apertures once observed by Claparède in 1868. Fertilization takes place as the eggs are laid in the tube. The male then assumes the maternal rôle and incubates the eggs. First of all he arranges them in the tube with his proboscis and then begins to execute regular undulatory movements which create a current of water over the developing eggs. These movements are continued without interruption during the whole period of development, during the ten days before the hatching and the further time before the young leave the tube and fend for themselves. All this time the male does not leave his brood in search of food. There is only one thing which mars this picture of paternal devotion, and that is the sad fate of the mother. Much weakened by the discharge of her eggs she is unable to defend herself, and within a few hours of her laying she is usually devoured by the male.

Nereis dumerilii (Fig. 1), another species of Nereid and one of the commonest worms found between tide-marks on our coasts, also has a strange history. It is polymorphic, and one may distinguish a bisexual form which at maturity undergoes a sexual metamorphosis known as epitoky, another bisexual form which does not suffer this change, and a hermaphrodite form. The hermaphrodites may be divided into two sets of individuals, the small green ones filled with ripe sperm which function as males, and the large yellow individuals filled with eggs which function as females. In the body cavity of the males are also found a few eggs and in that of the females a few sperm. The eggs in the hermaphrodite males and the sperm in the hermaphrodite females tend to disappear as the time for sexual activity approaches.

As with *Nereis caudata* the eggs are laid in a tube and their discharge is effected by rupture of the body wall; and the male takes on the task of incubation. The male and female of *Nereis caudata* live together in the same tube for several weeks before the eggs are discharged, but in *Nereis dumerilii* it is only a

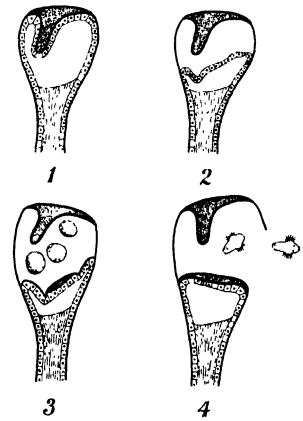


FIG. 3.—DIAGRAM SHOWING FORMATION OF THE INCUBATING CHAMBER IN *Spirorbis corrugatus*. (AFTER ELSLER.)

question of hours. As before, the male sets up a respiratory current to aerate the developing young and does not abandon his task until they are old enough to fend for themselves. The female does not survive the rupture of her body wall for many days, but the male lives on. He changes his sex and turns into a female.

Finally, certain species of *Spirorbis* (Figs. 2, 3) have a very curious mechanism by which they incubate their young. Our knowledge of this mechanism is due to the researches of E. Elsler. The Spirorbids are minute worms which form spiral calcareous tubes incrusting stones, rocks, seaweed, and the shells of other animals. So common are they that they can be obtained in great quantities anywhere by the sea. The animals always lie with their backs turned towards the substratum to which their tubes are attached. The terminal mouth is surrounded by a plume of gills, which consists of a number of axial filaments provided with paired ciliated barbules. One of these gills, the second from the median line on the right when the shell-spiral is dextral and on the left when it is sinistral, is without barbules, and the end is transformed into a conical stopper-like structure, the operculum. Formed from the dilated end of the branchia, the operculum is covered with a thick cuticle and bears on its top a calcareous plate which often carries on its under surface a sort of spur pushing down into the hollow cavity beneath it. This cavity, the opercular cavity, is completely closed on all sides. Elsler has shown that the opercular plate has a layer of cuticle both on its upper and its under sides, that is to say, that the whole of the calcareous part is outside the body. Now the animal uses its operculum as a sort of protective stopper to its tube. When disturbed it seals the mouth of its tube by pulling down the calcareous plate. It is also well known that certain species incubate their developing eggs beneath the calcareous plate of the operculum. The stalk of the operculum is of solid muscle and there is no possible communication between the cavity at its top and the body cavity in which the fertilised eggs lie, for the Spirorbids are hermaphrodite. Furthermore, the opercular cavity is lined by a roof of uninterrupted tissue.

How then can the fertilized eggs be incubated beneath the opercular plate? It used to be believed that the young were incubated in the opercular cavity itself, but this is not the case. The eggs do not develop in the opercular cavity, but in a space formed between the under surface of the plate and the epithelial roof of the opercular cavity. This roof breaks away from the plate which it has secreted, and the more the incubating chamber

becomes filled with eggs the further is the roof pushed downwards. Thus the incubating chamber is not formed from the opercular cavity but outside it. The roof, which has been detached to make room for the incubating chamber, now proceeds to secrete a second calcareous plate.

Two questions now arise : how do the eggs find their way into the incubating chamber, since it can have no possible communication with the body cavity, and secondly, how do the larvæ escape when once they are in ? The reader is reminded that the incubating chamber equally with the opercular cavity beneath it has no visible communication with the exterior, because when the lining of the latter cavity breaks away it leaves a stout calcareous plate above and solid cuticular walls at the sides.

To the first of the questions no answer is known. Elsler suggests that, when the roof of the opercular cavity becomes detached, an aperture may be formed in the cuticular wall of the incubating chamber, and as the animal frequently retracts its operculum to close its tube, the eggs which lie free in the tube may be pushed into the incubating chamber. The method of exit of the larvæ is, however, known. When they are old enough to fend for themselves a rent appears in the side walls of the incubating chamber. This hole always occurs at the same place, at the point where the wall of the incubating chamber joins the edge of the reduced opercular cavity beneath it.

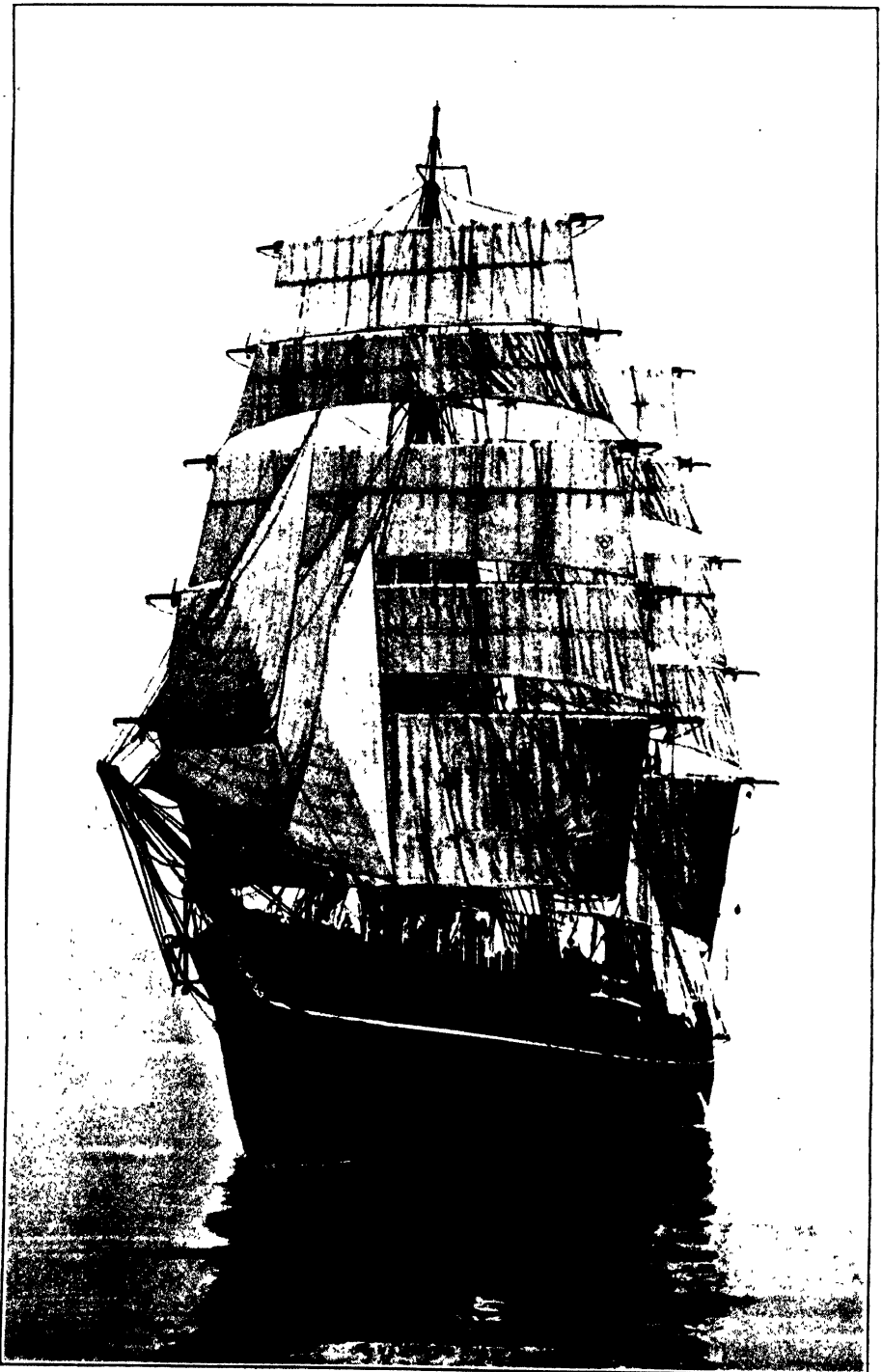
The incubating chamber is not used twice. A new calcareous plate is formed by the same epithelium which secreted the first, and in time the old plate is shed.

It will have been seen that incubation in the Spirorbids involves a curious and elaborate process, the origin of which remains a matter of pure speculation.

THE "DISCOVERY" EXPEDITION.

By STANLEY KEMP, Sc.D., Director of Research. "Discovery" Expedition.

THE principal object of previous expeditions to the Antarctic has been to increase our knowledge of the geography of the vast continent that lies around the South Pole. Everyone is acquainted with the hazards of such work, and the names of those who have been lost in this perilous type of exploration have an enduring memory. There is some danger that the present "Discovery" Expedition may be thought similar in scope and



Photograph by

J. Russell & Sons, Southsea.

FIG. 1.—ROYAL RESEARCH SHIP "DISCOVERY."

intention to these great polar expeditions of the past, more particularly as the chief vessel employed in the work was built for Captain Scott's first Antarctic venture.

It is thus needful in the first place to point out that the "Discovery" Expedition differs widely from any previously undertaken in the south, that the exploration of unknown regions, with its glamour and hardships, finds no place in its programme, and that it pursues by methods which are relatively prosaic a line of inquiry which is closely directed to the solution of a particular economic problem. This problem is a biological one, occasioned by the rapid expansion of the southern whaling industry in recent years, and the main purpose of the expedition is thus biological and not geographical.

The whaling industry in the north has had a most lamentable history and with every species which has been exploited its course has been the same. At first there is a period of rapid development, the industry expands and large profits are made, and this is followed by an equally rapid decline; the industry ceases owing to the scarcity of its quarry, and in no instance has the species concerned ever regained its former abundance. Such, to mention only two cases, has been the history of the Biscay Right whale, or Nordcaper, and of the Greenland Right whale, species which have been reduced almost to the point of extinction by whaling enterprise in the North Atlantic. Whaling in the northern hemisphere is now a mere shadow of its former greatness. Sperm whales, which once existed in vast numbers in subtropical waters, no longer afford the basis of an industry, and though desultory operations continue in various parts of the world, the centre of modern whaling enterprise has now definitely shifted to Antarctic seas. Here whales are being attacked in their last stronghold and, if history repeats itself, an important source of wealth will have been needlessly dissipated.

It is sometimes argued that sufficient safeguard exists in the vast extent of the southern ocean, where, owing to the lack of shelter for the vessels employed, the industry can only be prosecuted in a few comparatively restricted areas. Against this, however, is to be set the far more deadly nature of modern whaling equipment and the fact that in each season a vastly greater number of whales is taken than in the heyday of northern whaling activity.

Twenty-four years ago the first whaling station was established in the south, at Grytviken (Fig. 2) in South Georgia. This island, together with the South Orkneys and the South Shetlands, all of which are Dependencies of the Falkland

Islands, are now the centre of the greatest whaling industry which has ever existed. The whales hunted are Rorquals. They resemble the Right whales in their manner of feeding, for the mouths of both are provided with a series of plates of baleen, or "whalebone," which by their close juxtaposition form a sieve for straining small animals from the water, but differ from them in a number of features, the most conspicuous being the smaller head, the much shorter baleen, and the presence of a dorsal fin. The most important species of Rorqual in the south



FIG. 2.—WHALING STATION, GRYTVIKEN, SOUTH GEORGIA.

were formerly the Blue whale, the Fin whale, and the Hump-back; but the last named, after some eight seasons' operations, showed a sudden and alarming diminution. Attention then concentrated on the other two species; these up to the present have been able to maintain their numbers and in recent years the industry has been very successful.

It may be mentioned here that the principal product of whaling is whale oil, which at its best is as clear as water and without the least trace of odour. It is principally employed in making soap, but during the war it was an important source of glycerine for the preparation of explosives, and was also largely

used in the manufacture of margarine. At South Georgia, where whaling stations are established on the shore, the entire carcass is turned to account. Blubber, meat, and bone are all tried out for oil, and the residue, when dried and powdered, forms bone and meat meal, sometimes employed as an ingredient in cattle-food, but more often used as a fertilizer. At the South Orkneys and South Shetlands the land is mostly ice-bound, and only at one place (Deception Island) has it been possible to establish a station on the shore. In these areas the work of

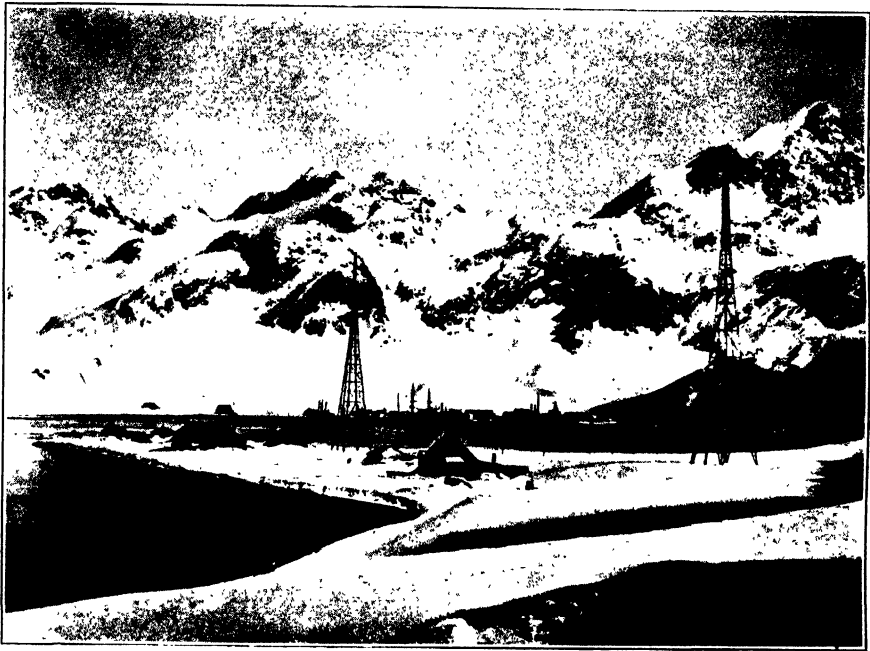


FIG. 3.—KING EDWARD COVE, CUMBERLAND BAY, S. GEORGIA, WITH SHORE LABORATORY IN MIDDLE DISTANCE ON LEFT.

trying out the whale is conducted on large vessels known as floating factories, and the manufacture of fertilizers cannot be undertaken.

Ever since whaling began in the south the importance of its proper administration has been in the minds of the Colonial authorities, and at an early date Committees were formed to examine the whole situation. The best possible regulations were framed for the control of the industry, but investigation showed that our knowledge of whales and of their biology was altogether inadequate, and it was accordingly recommended that an expedition should be sent to the south to study the whole

problem. The war intervened and for a time little could be done, but at its conclusion discussion was resumed and in due course the "Discovery" (Fig. 1), originally built for Captain Scott's first Antarctic expedition, was purchased and refitted for her new work. It was decided at the same time to build and equip a shore laboratory in South Georgia (Fig. 3), and, later, a second vessel, the "William Scoresby" (Fig. 4), named after a celebrated Arctic whaling pioneer, was added. The whole expedition is under the control of the "Discovery" Committee of the Colonial Office, and its cost is defrayed from funds raised in the Dependencies of the Falkland Islands.

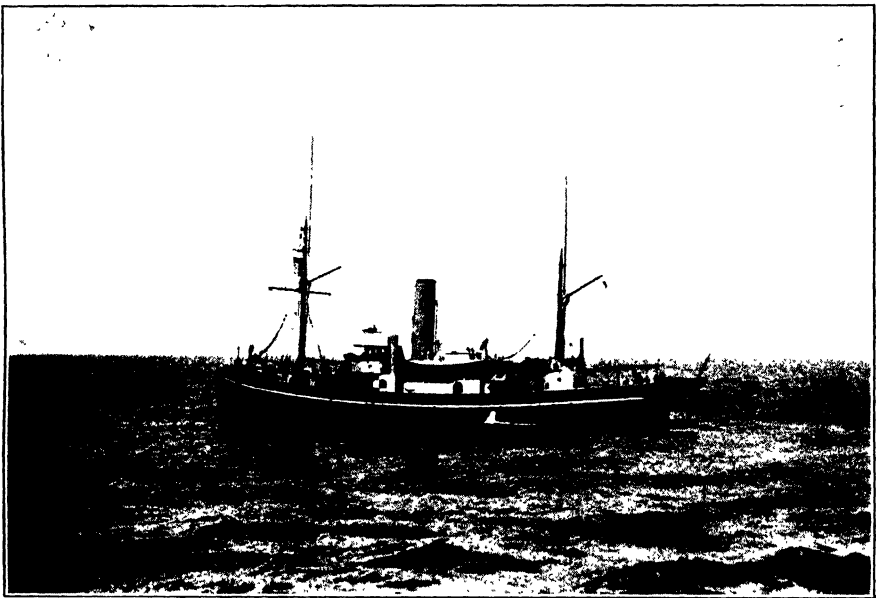


FIG. 4.—RESEARCH STEAMSHIP "WILLIAM SCORESBY."

It is thus the main object of the "Discovery" Expedition to obtain information which will be of value in the regulation of the whaling industry, and it will readily be understood that this is not an altogether easy matter. If it were only possible to take a census of the whales in the sea, then, with our recently acquired knowledge of their rate of increase and age of maturity, it would be a comparatively simple matter to determine how many could annually be taken without injury to the stock. But since this is impracticable, the "Discovery" Committee has wisely decided that every possible avenue of inquiry shall be explored. At the shore laboratory in South Georgia many of

the problems connected with whales themselves can be studied, and during the last three years much valuable information has been obtained on matters of primary economic importance—some of it new, and some confirming observations and suggestions made in the past. We know now with practical certainty that the chief breeding season of the Rorqual whales is in the middle of the southern winter, occurring at a period when they are largely absent from the southern whaling areas, that the period of gestation is between ten and eleven months, that twins and multiple births are rare, and that the females breed only in every



FIG. 5.—BLUE WHALE ON FLENSING PLANE, GRYTVIKEN, SOUTH GEORGIA.

alternate year. We know too that whales may be sexually mature at the end of their second year of life, and we are beginning to learn something of their rate of growth. We have accurate knowledge of the food that whales eat and much information on the parasites which infest them. Altogether, since the observations began in early 1925, over 1680 whales have been subjected to detailed examination by the officers of the shore laboratory. Never before has so large a body of evidence been collected, and the results, which are now being worked up, will undoubtedly prove of great value.

This shore work has been in progress for two and a half summer seasons at South Georgia, and for one winter season at Saldanha Bay in South Africa, and the officers in charge deserve great credit for the enthusiasm that they have shown under conditions of considerable discomfort. For life at a whaling station is not an enviable one; carcasses, blood, and grease form the environment, with a stench of such formidable quality that at its worst it is actually capable of turning white paint brown.

Part of the work at the shore laboratory relates to the specific characters of whales, for it is most important that we should know whether the Blue and Fin whales of the south are precisely the same type as the very similar forms which exist in the north. This work is being largely undertaken on statistical lines, and to obtain a sufficiently long series of measurements has proved a monotonous task. In connection with this work, and owing largely to the most generous assistance from Mr. L. H. Hansen, manager of one of the South Georgian whaling stations, various skeletons of whales have been prepared for the British Museum, and before long a shipment which will tax the resources of the preparators' department may be expected.

That whales, during their breeding season, are largely absent from the southern whaling fields is a point which has already been mentioned, and there are good reasons for supposing that the Rorquals at least undertake extensive migrations. The Humpback is known to travel northwards along the West African coast in April and May, breeding in the warm waters of the equatorial region and returning southwards in September and October. Of the Blue and Fin we have much less knowledge, but it appears incontestable that they behave in a similar way. Whales taken during the winter season in warm water usually have no vestige of food in their stomachs, while those killed in the south almost always show striking evidence of a healthy summer appetite. There is thus little doubt that these whales move northwards in the southern autumn on their breeding migration and southwards in the southern spring on their feeding migration. Of these migrations we require much more detailed information and, in particular, we need to ascertain whether they are longitudinal only, or whether there may not also be a latitudinal movement. If the former only occurs, it follows that the stock which is being exploited in the Dependencies of the Falkland Islands is entirely distinct from that on the other side of the Antarctic continent in the Ross Sea: if whales were to diminish in one area, it would have no effect in the other. If, however, as seems more probable, a latitudinal movement also

takes place, all southern whales are to be regarded as forming a single unit, and excessive hunting in any one area will eventually reduce the stock to a point when the industry is not longer profitable.

In an endeavour to throw some light on this problem of migrations, a system of marking whales has been adopted. The marking of salmon, plaice, and other fish has long been a recognized method of fishery research, but to evolve a suitable system for whales is obviously more difficult. The form of mark which is being employed is shaped like a large drawing-pin, fitted with barbs on the shank and attached to a light wooden rod which fits down the barrel of an ordinary 12-bore gun. The rod breaks away on impact and the mark, which bears a number and a suitable inscription, is left in the blubber with the disc lying flush with the skin. If such a marked whale is subsequently killed by a whale-catcher we may hope to learn something of the movements it has undertaken. This scheme is as yet only in an experimental stage; all that can be said about it at the moment is that it appears practicable, that some whales have already been marked and that it is hoped that it will ultimately prove a useful method of research.

The two vessels of the expedition, the "Discovery" and the "William Scoresby," have for the most part been occupied in a study of the conditions under which whales live, and lest it should be thought that this is a superfluous part of the investigations, it is necessary to give some brief explanation of its importance.

All animals are ultimately dependent on vegetation for their sustenance, and the vegetation in its turn is dependent on sunlight, which enables it to assimilate carbon from the atmosphere, and on the presence of certain solutions of salts. And this is as true of the sea as it is of the land, the difference being that the great bulk of the vegetation in the sea is in the form of tiny unicellular plants, known as diatoms, which float at or near the surface and are invisible to the naked eye.

In the south the Rorquals feed exclusively, or almost exclusively, on a small prawn-like crustacean (*Euphausia superba*) which occurs in immense swarms on the whaling grounds, and these euphausians live mainly in midwater and feed directly on the diatoms. Thus, with only one intermediate link in the chain, we are brought from whales, probably the largest animals the world has seen, to minute plants which require a high power of the microscope for their examination.

The importance of euphausians and diatoms is thus evident,

but even when these are taken into account we have not reached the end of the problem. For diatoms, in addition to light, require certain nutritive substances in solution in the water. These vary from time to time and from place to place, and both they and the diatoms themselves are under the influence of ocean currents and ocean drift. Investigations in the North Atlantic have repeatedly shown that mass movements of the water are the determining cause of the success or failure of a particular fishery, and there is no doubt at all that methods of research which have been effective in the north will prove equally useful in the south.

We need then to investigate this prawn-like euphausian, to learn its life-history, at present unknown, and to discover its relations with the organisms associated with it. We must study the physical conditions of the southern ocean and trace the movements of the waters which surround the whaling areas. In this way, if we can obtain regular observations over a number of years, we may hope to find the causes of the great seasonal concentration of whales in certain southern areas, and—a still more important matter—to understand the reasons for the marked seasonal fluctuations in their abundance. For in some years whales are plentiful, in others they are scarce. In some years it is the Fin whale which predominates, in other years the Blue. These differences are not due to chance; there are underlying causes and it is possible to discover them.

The system adopted in carrying out these investigations is to lay down a series of positions at each of which a standard programme of observations is to be undertaken. On the whaling grounds themselves the positions, or stations as they are generally called, must be close together—intervals of about ten miles are usual—in order to obtain as accurate an idea as possible of the conditions in these most important areas. Elsewhere a less intensive programme is all that is possible and the stations may be separated by distances exceeding 100 miles.

It will, of course, be readily understood that while it is comparatively simple to draw up a plan of a series of observations it is not always so easy to put it into effect. In the subantarctic waters surrounding South Georgia and the other Dependencies of the Falkland Islands the weather is notoriously bad (Fig. 6); westerly gales are prevalent and sometimes blow with almost unimaginable fury. Even when the sea is moderately rough, work can only be carried on with great difficulty, and in a strong wind and high sea it becomes altogether impossible. All that can be done is to watch one's opportunities and seize them when

they come, carrying on night and day so long as conditions permit.

The procedure at each station is briefly as follows. On arriving at the position the ship is stopped with the wind on the port side and meteorological observations are made. A sounding is then taken and a sample of the bottom deposit collected, and as soon as this is completed, operations with vertical nets and hydrographic apparatus begin. The nets (Fig. 7) are conical in shape, made of silk of various degrees of fineness,



FIG. 6.—R.R.S. "DISCOVERY" IN A ROUGH SEA.

and they are hauled through the water at an even speed of 1 metre per second. These nets are fitted with an ingenious apparatus by means of which they can be closed at any required moment, so that while the result of the operation is to filter a complete column of water from bottom to surface, the organisms contained in this column are separated out into different samples according to the depth at which they live. Thus the first haul is from 50 metres to the surface, the second is lowered to 100 metres and closed when it has reached 50 metres, the third is worked from 150 metres to 100 metres—and so on until the full depth has been reached. In the hydrographic work the

principal apparatus used is a "water-bottle" (Fig. 8), an elaborate instrument which belies its simple name. This instrument is operated by a sliding weight, or "messenger," which travels down the wire, and it is designed to give an accurate reading of the temperature at the depth to which it is lowered, and at the same time to provide a water-sample for subsequent chemical analysis. In deep water as many as twenty temperatures and water-samples are required at a single station.

It has been found in practice that vertically hauled nets,

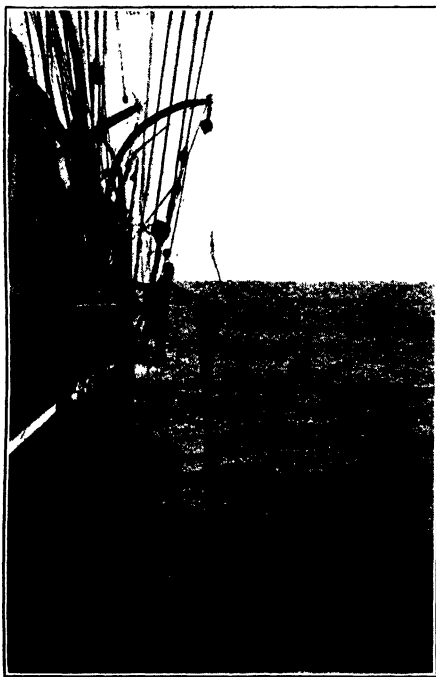


FIG. 7.—HAULING A VERTICAL NET.

while yielding excellent results with small organisms, fail to give an adequate idea of the larger forms which may be present in the area under examination; for the larger animals can by their own activity avoid these fine-meshed nets. Different methods must be employed, and consequently, when the work outlined above has been completed, the ship is got under way and other and larger nets are towed horizontally at a speed of two knots. These nets are of various sizes, the largest having a mouth $14\frac{1}{2}$ ft. in diameter. They can be closed so as to prevent an admixture of forms living in the upper layers of water while being hauled, and depth-gauges of various patterns are used with them to determine the

exact horizon in which the haul is made.

In good weather, and with a well-trained crew, the whole of these operations can be carried out in from one and a quarter to four hours, according to the depth of water. The accompanying chart (Fig. 9) illustrates the work done by the two ships at South Georgia during parts of December 1926 and January 1927. The operations described above were carried out at each of the positions which are shown, and as a result we possess data and collections from which a very accurate picture of the physical and biological features of the area can be drawn.

In addition to the investigations which bear directly on the

whaling problem, work in other directions has been undertaken. An officer attached to the shore laboratory at South Georgia has made a study of the Elephant seal, which is of considerable commercial importance as a source of oil production, and has also made valuable observations on the birds of the island. The "William Scoresby," during part of her time, has been engaged on a trawling survey in the neighbourhood of the Falkland Islands. Between these islands and the mainland of South America there is a large area of shallow water, and the object of the survey is to discover whether marketable fish exist on this plateau in sufficient quantity and of sufficiently good quality to form the basis of a trawling industry. Part of this work has already been accomplished, but much more remains to be done before it will be possible to discuss the results. The "Discovery" has also trawled and dredged on a number of occasions in more southern waters, mostly off South Georgia and in the Palmer Archipelago; though the number of fish obtained has on the whole been disappointing, the wealth of invertebrate life was truly astonishing both in its quantity and variety. A noteworthy feature is the presence in comparatively shallow water of types of animals which are normally taken only at a very great depth, a circumstance which may be explained, in part at least, by the similar and very low temperature of the water. The Chief Officer of the "Discovery" was a trained surveyor, whose services were specially lent by the Admiralty, and he used his rather scanty opportunities for survey to the utmost. By his work many additions and corrections can be made to the existing charts, and he has drawn plans of several harbours which had not previously been surveyed.

As was only to be expected since our main object was biological, the biological collections which have been made in the

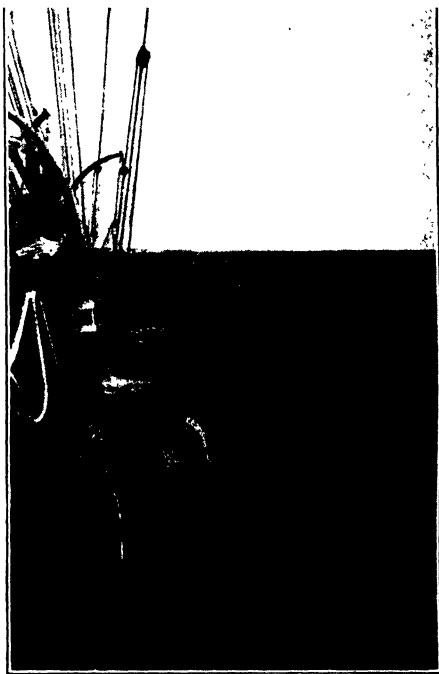


FIG. 8.—WORK WITH THE WATER-BOTTLE.

course of the work are probably more extensive than any previously made in the Antarctic. The collections representing the fauna of the sea bottom of the Dependencies are very rich, but richer still are those of the pelagic fauna, and these come not from any isolated area but from a very wide extent of the South

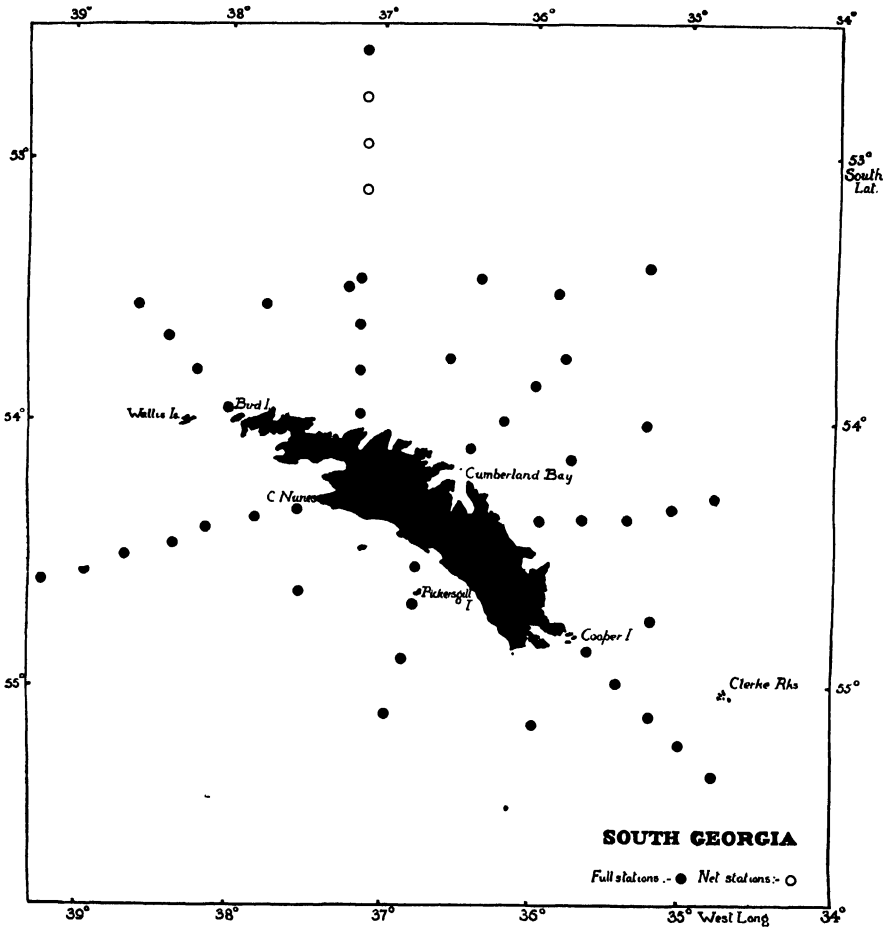


FIG. 9.—CHART SHOWING WORK DONE AT SOUTH GEORGIA,
DECEMBER 1926-JANUARY 1927.

Atlantic. The large mid-water nets, in particular, yielded quantities of interesting forms, and, when work at considerable depths had been undertaken, the first glimpse of the catch was always a thrilling moment. For these deep-water pelagic species are often grotesque in structure, and their colours, black and silver for the fish and scarlet-red for the prawns, are no less strange.

At the request of the "Discovery" Committee the Trustees of the British Museum have kindly found accommodation on the Museum premises at South Kensington for the collections and scientific staff of the expedition. The whaling and hydrographic data are being worked up, and the long task of extracting results of economic value from the biological material has been begun. The systematic treatment of the Zoological collections is for the most part being entrusted to those with special knowledge of particular groups, and in this respect we are receiving most welcome assistance from several members of the Museum staff. The "Discovery" Committee has decided to publish the results in a style similar to that of the Zoological Reports of the "Terra Nova" Expedition, and some of the papers are already in the press.

In the meantime the work of the Expedition continues. The shore laboratory in South Georgia has been reopened and the "William Scoresby," notwithstanding the unusually severe ice-conditions in the south, has recently carried out a very extensive series of observations on the whaling grounds.

A CRYSTAL OF TOPAZ.

By L. J. SPENCER, Sc.D., F.R.S., Keeper of Mineralogy.

A REMARKABLE crystal of topaz purchased this year for the mineral collection is a fitting companion to the crystal of beryl which was acquired last year and is described on p. 107 of the present volume. As an exhibition specimen and as a noble example of a crystal it far surpasses any topaz previously in the collection. Also, it comes from a region—Madagascar—in which topaz appears to be of uncommon occurrence; at least we can safely say that this is the first Malagasy topaz that has ever come to England. The locality is stated to be Tsaratanana in the Maevatanana district, and the specimen was presumably found in a pegmatite vein. The crystal is well formed and is bounded by brilliant faces with sharp edges. It is water-clear with a pale tinge of blue. Although the crystal is of gem quality throughout, the colour is not sufficiently intense for the stone to be of any special value for cutting as gems. It measures $12 \times 11 \times 10$ cm., and weighs 2290 grams (11,450 carats, or just over 5 lb.).

The crystal is bounded by faces of the following crystal-

forms: basal plane c (001); prisms m (110) and l (120); brachydomes y (041), f (021), and X (043); and pyramids u (111) and i (223). [These being the indices of the faces when the three rectangular co-ordinate axes of reference are those adopted by Dana, namely, $a:b:c = 0.5285:1:0.4770$. Some other authors take the vertical (c) axis at twice this relative length, which doubles the last index in each case. It is necessary to

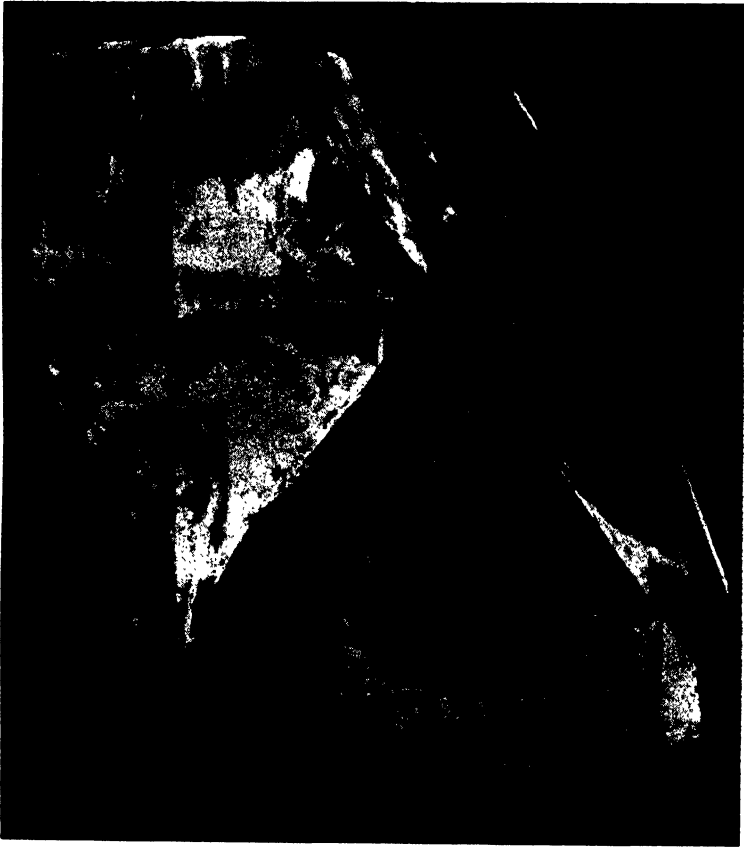


FIG. 1.—CRYSTAL OF TOPAZ FROM MADAGASCAR (NATURAL SIZE).

mention this, otherwise the indices and letters are themselves meaningless—a point that is very often overlooked.] Only half of the full number of faces (except the prisms) are present, as the crystal grew attached at one end and it has been broken away from its rocky support. The fracture has taken place partly along the direction of perfect cleavage parallel to the basal plane. This cleavage is a very characteristic feature of topaz, and is well shown by a clean crack through the middle

of the crystal. The faces of the forms $c y m l$ are largely developed, while those of $f X u i$ are quite small. Actually, however, all the faces are replaced by complex systems of vicinal faces and none of them is perfectly plane. In their

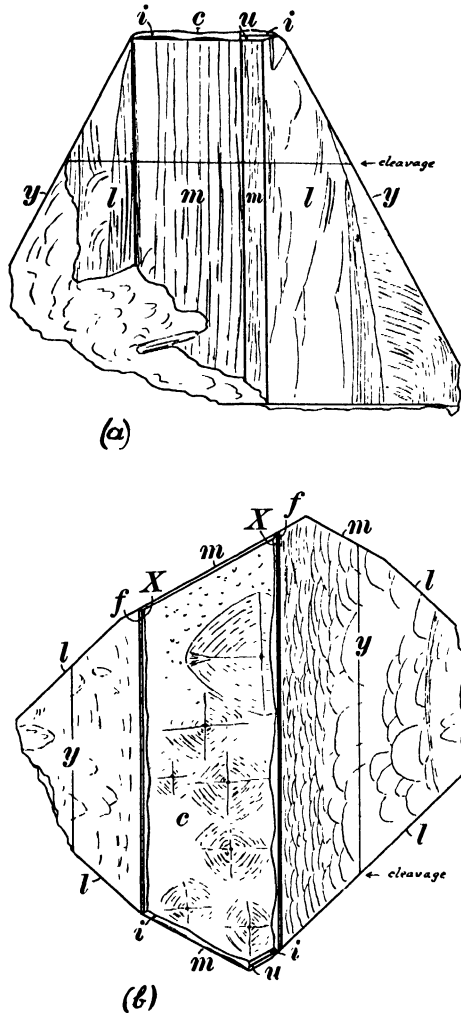


FIG. 2.—OUTLINE DRAWINGS (ELEVATION (a) AND PLAN (b)) SHOWING DIAGRAMMATICALLY THE SURFACE CHARACTERS.

positions they only approximate to the relative positions given theoretically by the above indices. We have here, in fact, a most instructive example of a crystal in which the process of growth was suddenly arrested, and it still shows the lines of growth by the complex markings on the faces. In the drawing

(Fig. 2) these can be represented only diagrammatically. When the faces of the crystal, reflecting the full glare of sunshine, are examined with a hand-lens, minute and intricate patterns may be seen. The very low "pyramids of growth" on the basal plane are remarkable in showing a minute pit at their apex. These pits closely resemble the "etch-figures" usually attributed to corrosion, but in this case they are clearly connected with the growth of the crystal. The markings on the faces of the large beryl crystal mentioned above are indicative of the corrosion of the crystal—after it had completed its growth it commenced to be re-dissolved. This pair of fine specimens tells us much about the natural history of crystals.

What is topaz? Chemically, it is a fluo-silicate of aluminium, in which part of the fluorine may be replaced isomorphously by hydroxyl (OH). It is a mineral possessing a high degree of hardness; and when it happens to be clear, transparent, and brilliant, and of a good colour, it is of value as a gem-stone. It has at present no other use or commercial value; but, when topaz is found in new country, search should be made for tin ore, as these minerals very often occur in association.

Larger crystals of topaz than the one here described are known. The largest on record is a rough, opaque, dull-coloured crystal two feet in length and weighing 137 lb. This came from a felspar quarry in Sætersdalen, Norway, and it may now be seen, standing up like a milestone, half-way down the Mineral Gallery. Another interesting specimen in the collection is a large water-worn pebble, weighing 12 lb. 13 oz., of clear colourless topaz, supposed to be from Ceylon, which was found years ago acting as a door-stop in a tea-shop in Fleet Street, London. Large crystals, up to 31 lb. in weight, have been found on the Urulga river in the Borshchovochnoi range, Transbaikalia. These are clear and of a dark wine-yellow colour, but, unlike the Brazilian sherry-coloured crystals, they fade on exposure to light. [For this reason the crystals in the collection from this locality are protected by cardboard covers.] A large crystal of gem topaz, weighing 90 lb., has recently been collected in Brazil by an expedition from the Field Museum of Natural History of Chicago.

LANDSLIPS IN DORSET.

By W. D. LANG, Sc.D., Keeper of Geology.

I. INTRODUCTION.

FROM time to time, and especially during the last few years, accounts have appeared in the daily papers of coastal landslips on the Devon-Dorset border, accounts which are often absurdly exaggerated, though containing a substratum of interesting fact. The phenomena are often confused, as, indeed, they are often combined, with the more familiar processes of coast-erosion; and a simple account of all the phenomena concerned may be of interest for explaining the nature of typical landslips, and distinguishing them from more usual forms of denudation.

Accounts of these happenings are by no means only of recent date. Have we not records of an earthquake at Lyme in 1689? "The late aged 'Tom Pearce,' a well-known admirable seaman . . . used to relate what his grandfather knew of the great slips to the westward, viz. those of 1689. . . . They were the *Earthquake* of that time. . . ." * But there were no geologists in those days to slake journalistic enthusiasms; whereas now, thanks to the pioneers in the early years of last century, we are able to deal scientifically with those coastal happenings.

The following are some examples, in geographical order, from west to east:—the destruction of the sea-front at Sidmouth, 1926–27; the Beer-Head landslip, 1790; the Axmouth landslip, 1830; the destruction of the parade at Lyme and the slipping of the Langmoor Gardens, 1926–27; the danger to Lyme Church from the receding cliff, 1840–present; the cliff-fires E. of Lyme, 1751 and 1908; the slipping of the Charmouth-Lyme coast-road, soon after 1825, and from about 1918 until the present; the threat to the same road from the receding cliff, 1924–25; the slipping of the land above the same road, 1928; and the collapse of the cliff above the western end of Fairy Dell, Stonebarrow, 1917–18.

Three separate phenomena must be distinguished:—(1) normal marine denudation, (2) normal subaerial denudation, and (3) typical landslips.

II. MARINE DENUDATION (Figs. 1–3).

The effect of marine denudation has been much over-rated. I do not mean that its action cannot be formidable under certain

* G. Roberts, 1840, "An Account of and Guide to the mighty Land-slip of Dowlands and Bindon," p. 14.

conditions. No one who has watched a beach of large pebbles reacting to a rough sea can doubt the sea's denuding power when other circumstances permit. But a glance at the cliffs on the Devon-Dorset border will show that subaerial denudation is nearly always going forward faster than marine denudation (see Fig. 4); for the cliff-tops have receded considerably further than the cliff-bases; and, except where the lowest part of the cliff is perpendicular, and high tides reach the cliff-base, marine denudation is confined to the planing of the fore-shore. Even where the tide reaches the cliff "under-eaten to its fall," recession has been but slow, and hardly ever overtakes that caused by subaerial denudation on the higher parts of the cliff.

Where subaerial denudation is rapid, the higher parts of the wasting cliff fall piecemeal to the beach, and there form a pro-

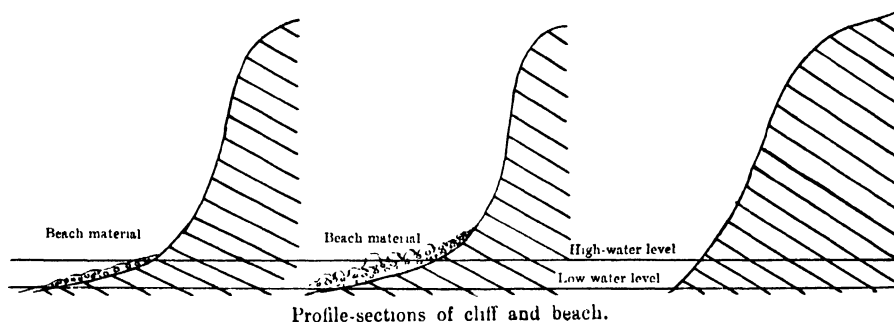


Fig. 1. Marine denudation. Fig. 2. No marine denudation. Fig. 3. No marine denudation.

tecting barrier of beach material which prevents the sea from reaching the cliff-foot at high tide (Fig. 2). This is particularly noticeable in a promontory like Golden Cap. On the other hand, where there is no beach, but the cliffs drop sheer into comparatively deep water (Fig. 3), there is no marine erosion, because, though the waves provide the power, they have no tooth, *i.e.* pebbles, or even fine solid matter in suspension, to gnaw with. Thus it is that stacks like the Needles or the Parson and Clerk rocks at Dawlish stand for, humanly speaking, indefinitely long periods. "No rock so hard but that a little wave may beat admission in a thousand years"; yes, but the wave must have a tool to work with, or at the end of a thousand years it will not have gained an inch.

Undoubtedly the Church Cliffs at Lyme have suffered considerably during the last two centuries from marine denudation, helped by the removal for lime-making of limestone ledges, which formerly offered some protection. A few groynes have now been placed beneath the churchyard in the hope of collecting

enough beach material for defending the cliff. The force of the waves broke the sea-wall at Sidmouth in 1926-27, and a stormy sea helped to damage the parade at Lyme during the same season, though the breach was primarily caused, I believe, by the weight of the sliding mud, which pressed on the parade from behind. Of late years sand and pebbles have been steadily removed by sea-currents from the beach immediately west of the Char Valley gap, and the cliff here has suffered considerably from marine denudation. The lowest part is a precipice, some fifty feet in height, capped by a layer of huge nodules known geologically as the *birchi*-bed (see Fig. 4). When the sea has removed enough of the cliff-base to make the whole precipice unstable, these big blocks come crashing down at intervals, to the potential detriment of visitors, who are accustomed to sun themselves below.

III. SUBAERIAL DENUDATION (Fig. 4).

Subaerial denudation is seen in the receding cliff-tops and crumbling cliff-faces. The clay surfaces become comminuted and washed away under alternate baking by the sun and soaking by rain and dew. Alternate freezing and thawing also lend a hand. Thus the more resistant limestone bands stand out from the clays and intermittently crash block by block as the underlying clay is removed. Various accidents may hold up what normally is a succession of small falls until a large piece of cliff comes suddenly away in a founder of clay and limestone nodules. Such a fall happened early in 1908 on the middle cliff-slopes about half a mile east of Lyme Church. The fallen shale contained much iron sulphide, which, soaked by the rainfall, decomposed rapidly, and, forming sulphuric acid, set the shale alight. A similar fire is recorded in 1751; but in 1908 lurid Press accounts of a "volcano" first brought the town such publicity that, in order to attract visitors, the Lyme people sought to prolong and augment the fire by adding paraffin. Later it was found (though it is hardly credible) that people were actually afraid of visiting Lyme on account of the "volcano." The fallen mass of shale burnt for a few months only.

Strong nodule-beds stay the general recession of the cliff so as to form terraces; and the falls from the precipices, lodging on the terraces, sometimes pile up very large talus-slopes. Since the falling is most frequent where streams make gullies, these areas of fallen clay become saturated and slide forward as though they were glaciers of mud. Where such areas of fallen clay do not lie in gullies they collect rain-water and form danger-

ous pools of mud, of the consistency of porridge in the middle and hardening towards the edge. The transition is more abrupt than visible, and a careless walker may easily become engulfed; in fact I have known this happen to a dog, which was entirely lost. Bones of horses and cattle, working out on the cliff, occasionally show how animals grazing on the higher slopes and straying over the edges may have disappeared.

I think that the Langmoor Gardens at Lyme are mainly a mass of fallen talus, which, held up by the parade, has remained fairly stable for a long period—long enough for the whole to have become grassed over. Exceptionally wet weather saturated

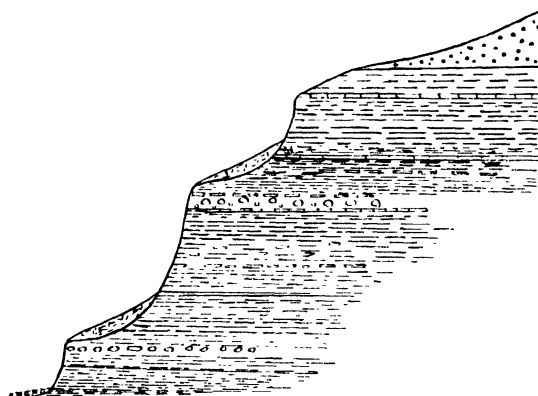


Fig. 4. Profile-section of Black Ven—the cliff between Charmouth and Lyme, showing how the top of the cliff is receding faster than the base; how the harder beds cause the cliff to weather in terraces; and how talus accumulates on the terraces.

this mass, which, becoming too heavy for the parade, broke and partly overflowed it in the winter of 1926–27. In that case, the obvious remedy is to drain the gardens thoroughly, and to build the parade upon arches, under which the clay could flow, if ever it again became so saturated.

IV. TRUE LANDSLIPS (Figs. 5–7).

The mechanism of true landslips is not so direct. Typically they occur where pervious strata overlies impervious strata with a sloping junction. Thus it is that true landslips and movements akin to them in our district have always taken place in the higher levels; for here are the pervious beds—chalk and sand—resting on lower clays.

The Axmouth landslip presents a structure of almost dia-

grammatic regularity, and the events which led up to it followed such a simple sequence that it has been looked upon almost as the type-specimen of landslips. Here all the conditions were staged

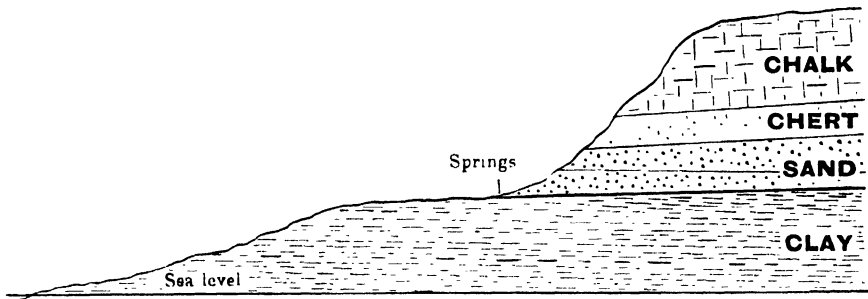


Fig. 5. Diagram of Landslip: 1.

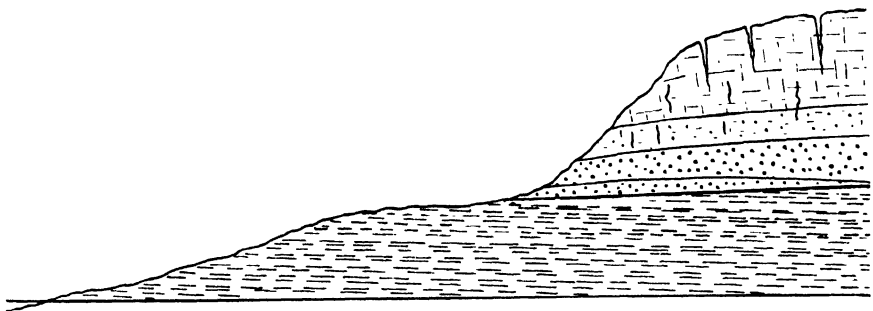


Fig. 6 Diagram of Landslip: 2.

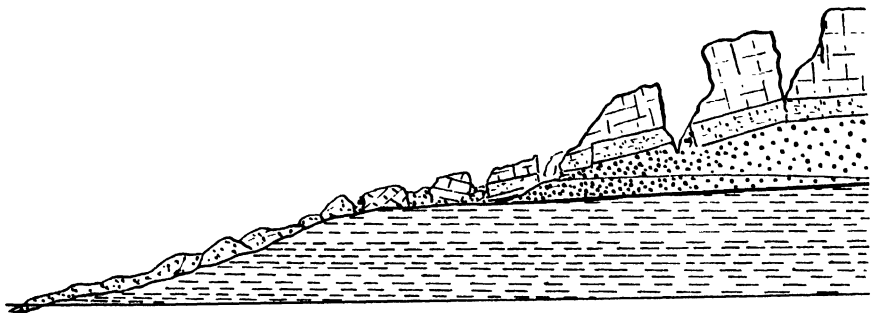


Fig. 7. Diagram of Landslip: 3.

for a landslide on a large scale. The porous Chalk at the top provided a catchment area for the rain, which, sinking through it and the underlying Chert and Greensand, was held up by the

Clay. The planed surface of the Lias and Rhaetic upon which the Chalk, Chert, and Greensand rested had a slight seaward tilt. Springs, consequently, poured out at the junction of the Greensand and Clay, especially on the seaward face of the cliff, where the junction was at the lowest level; and the lowest part of the Greensand became a saturated, almost fluid, mass lying on a gentle, but slippery, slope of Clay, and pressed upon by the enormous weight of the overlying beds. Moreover, the lowest part of the Greensand became increasingly washed out at the cliff-face, so that the remainder could no longer sustain the superposed mass. Then, at last, the brittle Chalk and Chert beds, giving way, subsided on to the saturated sand which was



FIG. 8.—THE CHARMOUTH-LYME ROAD THREATENED BY THE RECEDING CLIFF. 1927.

sliding seawards on a lubricated clay surface, and large areas of Chalk, Chert, and Greensand slid and fell on to the undercliff below.

This process must have happened repeatedly in the past, and formed the whole of the picturesque undercliff extending from Pinney Bay on the east nearly as far as Haven Cliff, Axmouth, on the west; but the last serious activity was at Christmas 1839, when it caused the great cleft at Bindon and Dowlands as well as the sinking of the cottages beneath Rousdon. This is graphically described by Roberts in a well-written booklet called "An Account of the mighty Landslip of Dowlands and Bindon," where the grandeur of the event and its reaction on the public mind are particularly mentioned. "Many are breathless and bewildered at the sight. One individual from Honiton was taken

home to a sick bed, from which he was with difficulty recovered.” * It is not as bad as that now; but the beauty of the tract is quite equal to its geological interest, and should be seen to be appreciated.

The Beer Head landslip of 1780 must have been essentially similar to that at Rousdon. East of Lyme, however, the Chalk and most of the Chert beds which formerly covered the hill-tops have been entirely removed by denudation, so that Greensand with but a mere capping of broken Chert beds there overlies the Lias. Otherwise the conditions are the same. Rain falling on



FIG. 9.—THE WESTERN END OF FAIRY DELL, STONEBARROW, an undercliff formed by the continual slipping of the Greensand at its junction with Lias clay. This photograph was taken in 1914, before the westernmost part was covered by a large fall of sand.

the Greensand catchment area soaks through the porous sand and is thrown out in springs at the Lias junction. The lowest part of the Greensand gets both saturated and washed away, and in time the overlying sand, generally piecemeal, but sometimes in large masses, presses the saturated and lubricated sand down the cliff and subsides on to it. This has happened on several occasions along the coast-road between Charmouth and Lyme since it was built in 1825, and of late years has so broken

* G. Roberts, *op. cit.*, p. 7.

it that it has been abandoned. At a spot rather less than a mile from Lyme Church and rather more than half a mile from Charmouth Church, the process has been gradual and the cliff has fallen piecemeal, eating back, until now the precipice actually touches the road (Fig. 8). The same has happened on Stone-



FIG. 10.—THE CHARMOUTH-LYME ROAD BROKEN BY SLIPS, 1926.

barrow Cliff, though a larger fall than usual occurred in the winter 1914–15, covering the western end of Fairy Dell with sand and so destroying the beauty of that undercliff that even now it is only slowly recovering its verdure (Fig. 9).

A few years ago the Charmouth–Lyme coast-road was actually broken at a point a little west of where the cliff has eaten back to its edge, as just described; and the movement which destroyed

it, having become dormant, revived early in this year, and is still in progress (Fig. 10). It is remarkable that the ground is now affected for a considerable distance above the roadway, and at a height where one would suppose that the sand held but little water. A spring, however, is reported near the base of the sandy cliff, which has here receded more than fifty yards from the road above the slip; and it is known that natural reservoirs do occur somewhat above the junction of the Greensand and Lias; in fact, it is from these that the water supplies of the villages are drawn. Possibly they exist where deposits of iron locally cement the sand and thus hold up water. If a reservoir of this kind has been opened up above the slipping roadway, the released water would account for the sand being saturated above the normal level, and for the consequent extension of the slipping to an unusual height.

A REMARKABLE BUG WHICH LURES ANTS TO THEIR DESTRUCTION.

By W. E. CHINA, B.A., Assistant, Department of Entomology.

MOST people are aware of the fact that in a few instances animals form snares in which to entrap their food. The case of the spider's web is familiar to all, and perhaps the pitfalls dug by Ant-lion larvæ are also well known. There are, however, still fewer and less known cases in which various parts of the body are adapted to act as a lure or bait. For example, an Asiatic lizard (*Phrynocephalus mystaceus*) possesses pink flower-like structures at the corners of its mouth, which are said to allure flies within reach of its jaws. In the Southern States of America there is a Terrapin (*Macrolemmys temminckii*), which lures its prey by means of the active agitation of worm-like filaments below the anterior end of its tongue. The Terrapin itself remains motionless, and is coloured to resemble the surrounding rocks, so that the tongue filaments have the appearance of worms moving in a crevice in the rock. Then there is a pinkish white Malayan Mantis (*Hymenopus bicornis*), which takes up a position amongst clusters of flowers, and adopts a peculiar attitude so that it bears a striking resemblance to a blossom. At the tip of the insect's abdomen is a black spot, which looks like a small fly resting on the flower, and this acts

as a decoy. Perhaps the most remarkable cases of such lures are found in the Angler fishes; they attract their prey with a lure or bait suspended over the large mouth by means of the first ray of the dorsal fin, which is modified to form a long flexible line. In the Angler fish (*Lophius piscatorius*) the lure is a flap of skin and the body of the fish is concealed, whereas in its deep-sea relatives (Ceratioids), which live in darkness, the lure is phosphorescent.

A very interesting case is that of certain blue butterflies (family Lycænidae), of which the Large Blue (*Nomiades arion*)

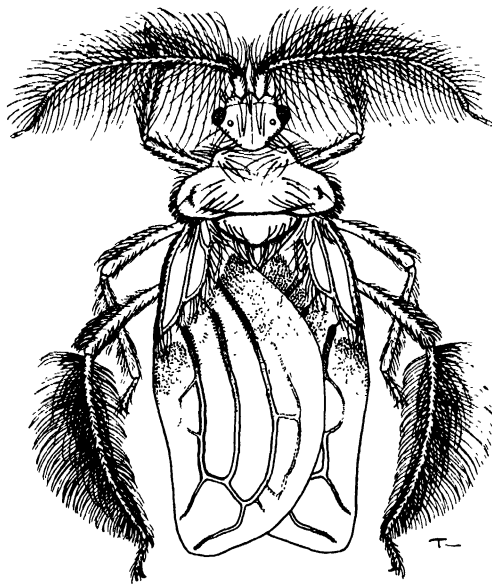


FIG. 1.—*Ptilocerus ochraceus* Montandon, ♀ (ten times natural size): a bug which lures and destroys ants.

is a well-known British example. The larvæ bear on the tenth segment a longitudinal dorsal gland, capable of secreting a sweet liquid very attractive to ants. The gland, however, functions only when touched by the ants, which readily drink the drops of liquid exuded. After the third moult, the larva wanders about until picked up by an ant (*Myrmica scabrinodes* or *M. lævinodis*), which promptly carries it into the nest. Here the caterpillar passes the winter sheltered from the elements and feeding on the larvæ of its hosts, which do not molest it. Pupation takes place in the ants' nest, from which the adult butterfly emerges during the following summer. In other

cases Lycænid larvæ sheltered by ants are known to feed on scale-insects, which also inhabit the nest.

Among bugs of the sub-order Homoptera there are numerous species, especially in the families Aphididæ, Coccidæ, and Membracidæ, which excrete or secrete, sometimes from special glands, a sugary liquid very attractive to ants. These insects, as is well known, are frequently tended and protected by the ants for the sake of their sweet secretions, and many species even live in the ants' nests and are carried about from one food plant to another by their attentive hosts. We have seen how the Large Blue caterpillar makes use of the ants' taste for such

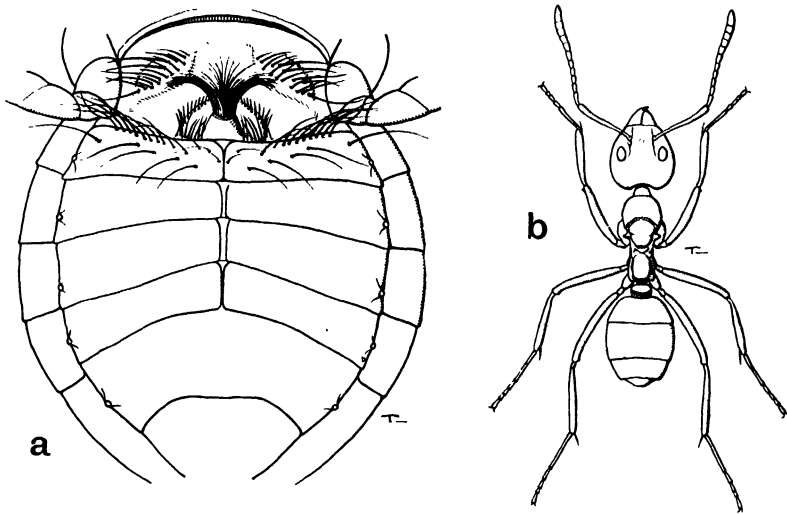


FIG. 2.—a. Under side of abdomen of *Ptilocerus ochraceus*, showing the tuft of hairs (trichome) from which the ants obtain the intoxicating liquid. b. The ant, *Dolichoderus bituberculatus* Mayr, on which the bug preys.

secretions in order to gain entry to their nests for the purpose of preying on their larvæ. In Java and Sumatra this same weakness sometimes leads to the wholesale destruction of the worker ants by a remarkable Heteropterous bug (*Ptilocerus ochraceus*) of the family Reduviidæ, of which specimens have recently been acquired by the Museum. The habits of this bug were first described by the well-known Dutch entomologist Mr. E. Jacobson, of Sumatra, and the following account is based on his report (*Tijdschrift voor Entomologie*, 1911, vol. liv, pp. 177–9). Jacobson frequently found the species in bamboo sheds surrounding a bathing place at Wonosobo in Central Java, especially amongst the bamboo poles of which the roofs were constructed. The bugs were attended by large numbers

of small black ants belonging to a common Javan species known as *Dolichoderus bituberculatus*, which made their nests amongst the leaves of neighbouring trees. Most of the ants in the vicinity of the bugs were in a more or less paralyzed condition, and the ground beneath them was in some places covered with dead ants to the depth of an inch. Although the corpses were regularly carried off by another species of small red ant, fresh victims dropping from the roofs continually replaced those taken away. On the middle of the lower surface of the second segment of the abdomen the bugs possess a peculiar tubercle covered with a tuft of golden-coloured hairs, which conceal an opening leading to a special gland. The entire organ is called a trichome, and the gland apparently secretes some substance very agreeable to the ants, since the latter are attracted to the bugs in great numbers. On the approach of an ant of the right species, the *Ptilocerus* at once becomes alert, raising its front legs above its head and exposing the organ at the base of the abdomen. The ant forthwith proceeds to lick the trichome, all the time pulling at the hairs with its mandibles as if milking the creature, so that the body of the bug is continually moved up and down. Meanwhile the *Ptilocerus* takes the head and thorax of its victim between its front legs, placing the point of its beak behind the ant's head at its junction with the body. For some minutes the bug restrains itself while the ant goes on licking the trichome. Presently the secretion begins to exert a paralyzing effect, and the ant curls itself up, drawing in its legs. The bug immediately seizes its victim with its fore-legs, pierces it with the barb-like mandibles ensheathed in the beak, and sucks it dry; it may be added that both the larvæ and adults of *Ptilocerus* feed in this way. Sometimes, after sucking at the trichome for a short while, an ant will leave the bug and retire to a distance as though suspecting the murderous intent of its comforter. But sooner or later paralysis overtakes the poor creature, and it drops to the ground amongst its dying companions. In this way many more ants are destroyed than are needed as food.

The bugs are very sluggish in their movements, depending entirely on the power of attracting their prey. Owing to the hard chitinous armour of the ants, it is necessary for the bug to select with care some weak place in it, such as the suture, at the base of the antenna, for the insertion of its piercing mandibles. This may explain why the fluid secreted by the bug is not only attractive, but poisonous to the ants, because unless its victim is paralyzed it is impossible for the bug to make an

accurate thrust without disturbing the ant. It is interesting to note that the protective scent-glands usually present in Heteropterous bugs are obsolete in this species, as, indeed, they are in most members of the rapacious family (Reduviidæ) to which it belongs, so that no objectionable smell can interfere with the attractive odour of the special secretion.

THE EASTERN OR KIVU GORILLA.

By J. G. DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

THE Eastern or Kivu Gorilla was discovered in the year 1903 by Oscar von Beringer and was described by the late Dr. Matschie under the name *Gorilla beringeri*. The Western Gorilla (*Gorilla gorilla*) has been known since the days of Du Chaillu, who gave the first popular account of this ape in his "Equatorial Africa," published in 1861.

The Kivu gorilla is very closely allied to its western cousin, being distinguished chiefly by the longer hair on the head and body. The original locality, from where this gorilla was first described, is the Birunga Mountains which lie to the north-east of Lake Kivu. These mountains are a chain of active, dormant, and extinct volcanoes. Of these can be distinguished an eastern group consisting of Mounts Muhavura, Mgahinga, and Sabinio, which form the present boundary between western Uganda and Ruanda. The central group, which contains the highest mountains of the range, consists of Mounts Karisimbi, Mikeno, and Visoke. The western group comprises the only active volcanoes of the chain, namely Niragongo and Namlagira, which stand close together but are not connected with the eastern or central groups. Karisimbi is the highest mountain in the locality (14,600 feet), and Mikeno, the favourite haunt of the gorilla, rises to a height of 14,385 feet; both these are extinct volcanoes, as is also Visoke (12,568 feet). The latter mountain is connected by a saddle with Mount Sabinio of the eastern group, which rises to a height of 11,960 feet. Muhavura, a dormant volcano, is 13,547 feet, and Mgahinga reaches an altitude of 11,400 feet. The westerly mountains, Niragongo and Namlagira, are the smallest of the range, measuring 11,250 feet and 9,766 feet respectively.

The gorilla is found in both the Sabinio and Mikeno groups, but the latter may be regarded as its chief habitat.



EASTERN OR KIVU GORILLA.

Doubtless these animals wander from one group to the other across the forest-clad saddle connecting Sabinio with Visoke. Although gorillas may occur occasionally on Namlagira and Niragongo, such animals may be regarded as migrants from the Sabinio or Mikenso groups.

Since 1924 the gorillas on the Birunga Mountains have been very strictly preserved by the Congo authorities, and the indiscriminate slaughter of these interesting beasts has been effectually stopped, permission to shoot a gorilla being granted only on very special occasions.

A specimen recently acquired came from the south-west corner of Lake Kivu, at an altitude of 8000 to 9000 feet, roughly latitude $2^{\circ} 25'$ S. and longitude $28^{\circ} 35'$ E., so that it cannot be regarded as topotypical of the Birunga gorilla. There appears, however, to be no reason to regard it as representing other than *Gorilla gorilla beringeri*, the name by which the Eastern gorilla is known. The specimen was mounted in the Rowland Ward studios.

There exists a very marked difference between the sexes, the female being much smaller and without the well-marked crest which the male appears able to erect when angry or excited. The female is, moreover, self-coloured, the body being covered with long blackish hairs, whereas the male has a well-defined greyish-white marking on the back, rather like the hind part of a waistcoat, and, as can be seen from the illustration, its chest is quite naked, there being a sharp line of demarcation between the bare and hairless torso and the hairy belly. The young gorilla is clothed all over its body with blackish-brown hair, showing no sign of the naked chest or light dorsal marking of the adult male.

The old males are in the habit of beating their bare chests with their hands, not, apparently, because they are angry, but, according to Major Powell-Cotton, because they desire to call their families back when they consider they are wandering too far away. Mr. Marius Maxwell also notes that this chest-beating is usually carried out in some dense thicket and where the animals have not been disturbed; thus the picturesque stories and illustrations of gorillas advancing to the attack drumming on their chests may be regarded as more in the realm of fiction than fact.

A full-grown male gorilla will weigh between 400 and 500 lb. and measure from 5 ft. to 5 ft. 6 in. in height; the chest measurement may exceed 60 in. The adult female is considerably smaller, rarely exceeding 4 ft. in height.

The Eastern Gorilla appears to be less arboreal in its habits than the gorilla of the western forests, although young and immature individuals are occasionally to be seen climbing about fairly high up in search of food. They do not hurl themselves from branch to branch in the same manner as does the orangutan, whose limbs are better adapted to such headlong travelling. The old males appear to be still less arboreal, searching for their food near or on the ground. Their favourite food consists of bamboo shoots and a variety of other plants, together with berries and the soft bark of certain shrubs. When feeding, a troop of gorillas is frequently very noisy; Mr. Maxwell reports that the noise proceeding from a troop feeding in bamboo forests is about equal to that produced by several elephants feeding in similar vegetation. The troops vary in size; sometimes as many as a couple of dozen go to make up a family party; each group appears to have a separate lord and master.

Their sleeping-places are of two kinds; firstly, low-built platforms constructed of twigs and leaves, and commonly used during the day only, and secondly, sheltered retreats in the hollow bases of the large *Hagenia* trees, which are made use of principally at night or during heavy thunderstorms. The young ones are thought by Mr. Maxwell to huddle round their parents during the night; the old or adult gorillas appear to prefer their nests built close to the ground, but immature members of the troop frequently construct their resting platforms some four to six feet above ground level. These platforms are rarely used more than once, the animals, being very migratory, building new resting-places every day.

The adult gorilla has no foes to fear except man, as not even the large carnivora would interfere with an adult male. Leopards appear, however, to levy a fairly heavy toll on the younger generation, and this may be the reason why immature gorillas build their nests off the ground and seldom stray far from their adult relations.

In addition to this Kivu specimen the Museum collection possesses five other mounted specimens of the Eastern gorilla, an adult male and female, an immature specimen and two young ones. It is hoped, at some future date, to be able to arrange these specimens as a natural group.

RECENT IMPORTANT ALTERATIONS AND ACQUISITIONS.

The congestion of the Central and North Halls has been relieved by the removal of some of the exhibits and the rearrangement of the statues in the former; the statue of Darwin is now placed near the main entrance, facing that of Huxley, and is seen to greater advantage than in its old position on the stairs.

The large African elephant, which was sent in April 1927 to the Rowland Ward studios for remounting, has been received back. It once more stands in the Central Hall, together with the mounted Indian elephant that has been displaced from the Geological Galleries to make room for the Upnor elephant.

Exhibits of Oceanic Angler-fishes (*v. p. 69*) and of Wood Wasps have been placed in the Central Hall. The Mimicry case has been reorganized and examples of mimicry in beetles added to it.

The African Elephant Scene (*v. p. 97*) has been provided with a new glazed front which permits of an uninterrupted view of the picture. In order to obviate as far as possible the interference due to reflection from the near side of the glass, a covered screen has been placed in front of the exhibit. This screen has been used for displaying a series of enlarged photographs of herds of African elephants. By the pressure of a switch button the lighting of the exhibit passes through a cycle representing sunlight and moonlight.

The group of Spanish Ibex (*v. p. 106*) presented by the King of Spain has been removed to a commanding position on the Bridge-Stairs in the Central Hall which connect the First and Second Floors of the building.

An addition to the Bird Gallery, of peculiar interest to London visitors, is the case near the entrance containing specimens of the birds which from time to time may commonly be seen in the London parks.

Additions to the Lower Mammal Gallery include the new gazelle shot by the Duke of York (*v. p. 129*), a Persian tiger and a South African leopard (*v. p. 162*), and a young tiger from Cooch Behar, India.

The very large fossil elephant (*v. p. 99*), *Elephas antiquus*, from the pleistocene of Upnor, Kent, has been placed on exhibition in the Gallery of Fossil Mammals, and in the adjoining Fossil Reptile Gallery a remarkable Armoured Dinosaur has recently been set up.

An exhibit illustrating the vegetation of Africa has been completed in the Botanical Gallery. It consists of three parts: a relief map of the continent on which the vegetation zones have been painted; a series of typical landscape photographs; and specimens and pictures of especially important or conspicuous plants. The localities of the numbered photographs are shown on the map by corresponding numbers. A special section of the exhibit contains actual specimens of characteristic plants from temperate South Africa.

A series of coloured transparencies of the larger British fungi recently purchased has been arranged in a table-case for exhibition in the Botanical Gallery.

* * * * *

Mrs. Ruxton, mother of the late Commander R. E. Ruxton, R.N., has presented £50, which is being used for the purposes of an expedition in South America.

The Directors of Paramount Pictures have presented a copy of the nature film "Chang" depicting jungle life in Siam, together with records of the actual animal sound effects, which are synchronized with the picture, and documents giving the history of the taking of the picture and the creation of the animal sounds. It is a condition of the gift that the air-tight case containing it shall not be opened for fifty years.

Department of Zoology.

A skull of a sperm whale killed off Durban, Natal; presented by the High Commissioner for the Union of South Africa.

Mounted specimen of a young Sumatran Rhinoceros; presented by His Highness the Sultan of Perak.

Skin and skeleton of an Eastern Gorilla (v. p. 213); purchased. The acquisition of this specimen was rendered possible by the generosity of Lord Rothschild, F.R.S.

A large collection of mammals, birds, and birds' eggs from Abyssinia; purchased.

An important collection of leeches, earthworms, tapeworms, etc., and a collection of millipedes from Colombia; purchased.

Two shells of the extremely rare and much-prized gastropod *Voluta bednalli*; purchased.

Ten monkeys from the Upper Solimões River, Brazil; purchased.

A collection of African mammals from Mount Kenya; purchased.

Mounted specimen of an immature Snow-Leopard from the north-west Himalayas (v. p. 177); purchased.

Department of Entomology.

A collection of European and exotic Coleoptera and of Homoptera Heteroptera; bequeathed by the late Mr. G. C. Champion. The major portion of the bequest consists of some 120,000 beetles from various parts of the Continent, forming probably the richest European collection in the country.

A collection of 8406 Lepidoptera; presented by Mr. G. T. Bethune-Baker. This collection includes a large number of types and paratypes of species described by the donor, as well as the entire Richard South collection of British Tortricidæ, numbering 5574 specimens.

A remarkable new moth with very long tufted hind legs (or rather feet), belonging to the family Ecophoridæ; presented by Colonel R. H. Penton. This is one of two specimens captured by the donor in his garden at Ranikhet in the Himalayas 8000 feet above sea-level.

A series of 218 specimens, of which 197 (21 butterflies and 176 moths) are types, of New Guinea and Madagascar butterflies and moths, presented by Sir George H. Kenrick. Many of the types were described by the donor, and the series includes the Malagasy *Geometridæ* described by Mr. L. B. Prout and a few species described by Mr. G. T. Bethune-Baker. Hitherto, many of the species described by Sir George Kenrick have been represented in the Museum Collections only by a figure, and in a number of instances the type has remained unique to this day; this applies especially to the Malagasy species, since Madagascar is rarely visited by British collectors. Most of the material from New Guinea in the present acquisition was collected by members of the Pratt family, father and sons, in the years 1902-03, 1909-10; that from Madagascar was collected entirely by Mr. F. B. Pratt in 1911. Apart from its scientific value, the beauty, variety, and excellent condition of the material obtained by the late Mr. A. E. Pratt and his sons render it a matter for regret that the services of the Pratt family are no longer available, especially seeing that recruits to the ranks of professional collectors of insects are all too few.

The complete collection of Lymantriidæ formed by the donor, Mr. J. J. Joicey. This magnificent gift, consisting of nearly 6000 specimens from all parts of the world, includes the types of 92 species described by various authors.

A fine specimen of *Megasoma janus*, presented by Capt. K. J. Haywood. This is one of the giant horned beetles, of which it is believed that only two

examples, both imperfect, have ever before reached this country. The legs of this insect, when fully extended, cover a space of about six inches from front to rear.

A collection of 850 specimens of Lepidoptera made by Mr. H. Portal Hyatt in Liberia; purchased. This collection will throw light on the distribution of the butterflies and moths of West Africa, and, inasmuch as so little is known of the entomology of Liberia, it will probably contain much that is new to science.

An important collection of Hymenopterous parasites of insect pests of field crops and forest trees; purchased.

A valuable series of fleas from Manchurian ground squirrels; purchased. These fleas include specimens of species of practical interest and importance, on account of the possibility that, like the tropical rat-flea, they may be concerned in the spread of plague.

The Croissandeau collection of exotic Scydmanidæ, consisting of 856 specimens, nearly all named, and including 116 types; purchased.

Department of Geology.

A collection of small fossils from the Barton Clay of Hampshire; bequeathed by the late Mr. H. Eliot Walton.

A collection of about 500 seeds and fruits collected in the Upper Eocene clay of Hordle, Hampshire, and presented by Miss M. E. J. Chandler. They have been described by the donor in the monographs of the Palæontological Society and many are new to science. The whole flora shows relations to that now living in the Far East, and indicates a warmer climate than is experienced now in the British Isles.

Ammonites and other fossil cephalopod shells from the Gault of Dorset; presented by Lieut.-Col. R. H. Cunningham, R.E.

1000 ammonites belonging to about 14 species collected from the Gault of Glyde, Sussex, and presented by Mr. C. T. A. Gaster.

Four slabs containing tracks of extinct animals; presented by Mr. A. W. Clayden.

Casts and specimens of the remarkable primitive fishes found by the donor in the uppermost Silurian rocks of Ringerike, Norway; presented by Professor Kiaer. These ancient forms are closely related to the modern lampreys, and the backbone runs into the lower lobe of the tail, whereas in modern fishes with a symmetrical tail it is the upper lobe that receives the backbone.

A series of 28 fossil fishes collected in the brickpits of St. Peters, a suburb of Sydney, and presented by Mr. B. Dunstan, Government Geologist of Queensland. These rocks are said to be of Triassic age and form the upper part of the Hawkesbury series, but Sir Arthur Smith Woodward, who described the fishes in 1908, found that those coming from the shales were like the older Carboniferous and Permian fishes, while those from the mudstones were Triassic or even Rhætic in character. The collection includes counterparts of four of Sir A. Smith Woodward's type-specimens. The most remarkable is a magnificent example, five feet long, of the primitive shark-like fish *Pleuracanthus*, a genus in which the skeleton of the fins was built on the antique plan, with a mid-rib from which rays were given off on both sides, as in the present lung-fishes; it also had a large head-spine. Specimens of *Sagenodus* represent the group of lung-fishes, to which the modern Australian *Ceratodus* belongs, but most of the fossils are Palæoniscids, a versatile group of armoured fishes with cartilaginous backbone (Chondrostei), from which probably arose most of our modern fishes other than sharks and lung-fishes.

Part of a lower jaw of a new genus of Carnivora, which has been named *Dyspterna woodi*, found in the Oligocene Hempstead Beds of the Isle of Wight, and presented by Mr. S. L. Wood.

Pupa-case of a Dragon-fly found in the Rhætic plant bed near Bristol by the donor, Mr. W. H. Wickes.

147 shells from the Cretaceous and Pliocene rocks of Angola collected and presented by Mr. Beeby Thompson.

Five bony fishes from the Eocene of Egypt, including a new sole and a new form of primitive eel, discovered and presented by Mr. C. Crawley.

Cephalopods collected by the donor from the "Junction bed" of the Lias, near Bridport, Dorset; presented by Mr. J. F. Jackson.

A large number of fish remains, collected from the Blackheath beds, below the London Clay, of Abbey Wood, Kent, by the donor, Mr. F. J. Epps.

Devonian and Carboniferous invertebrate fossils from America; presented by Mr. E. W. J. Moore.

Type-specimens of Carboniferous Corals from Yorkshire; presented by Prof. R. G. S. Hudson.

Crinoids from the Devonian of southern Peru; presented by Dr. J. A. Douglas.

Three plaster casts of type-specimens of Starfishes from the Lower Devonian, near Goslar; presented by the Director of the Preussische Geologische Landesanstalt, Berlin.

A rare Brittle-starfish from the London Clay of Bognor; presented by Mr. E. M. Venables. This specimen is remarkably well preserved and shows clearly the structure of the animal.

Type and figured specimens of Ammonites from the Gault of southern England; presented by Dr. L. F. Spath.

Ammonites from the Upper Jurassic of Hautes Alps; presented by Monsieur C. A. Matley.

A nodule from the London Clay containing specimens of an undescribed gastropod; presented by Mr. J. E. P. Spencer.

Lamellibranchs from a prehistoric shell-heap in Sumatra; presented by Mr. J. R. le B. Tomlin.

Two reptile skulls from the Trias of Brazil; presented by Dr. W. Rau.

Fossil from the lithographic stone of Solnhofen, Bavaria; purchased. This curious fossil looks like two pieces of a large curved feather and has been puzzling the German geologists. The Museum authorities incline to consider it as a colony of hydroid polyps, related to the modern sea-animal known as the Sea Fir. This fragment was no doubt torn up by a storm from a neighbouring sea-floor and swept on to the flats of the Solnhofen lagoon at the time when our Kimmeridge Clay was being laid down.

Fossils from the London Clay, including the shell of a Pinna in which were several pearls; purchased.

Department of Mineralogy.

A crystal of topaz from Madagascar (*v. p.* 197); purchased.

A remarkable set of very large specimens of crystallized spar from the Snailbeach mine near Minsterley, Shrewsbury; bequeathed by the late Mr. William Oldfield.

The fine mineralogical collection of upwards of 3000 specimens, mainly from Australia, which was brought together by the late Professor A. Liversidge, F.R.S., and was bequeathed by him. It includes a mass, weighing 65 lb. (29.5 kg.), of the Thunda meteoric iron and about 40 other specimens of meteorites; about 40 sections of gold nuggets, cut to show their internal

structure, and about 40 gem-stones, besides lantern and microscope slides, photographs, etc.

A group of large octahedra of pink fluorspar, on white matrix, from the Goeschenen valley, Switzerland. This specimen has been acquired for the Museum Collection by the generosity of Mr. F. N. Ashcroft, and may be compared directly with the rose fluors presented by Ruskin in 1850.

Various minerals, including willemite (zinc silicate), native silver, silver iodide, mimetite, scheelite, and copper-ores, from Northern Rhodesia; presented by Mr. R. Murray-Hughes.

A sample of the meteoric dust ("red rain") that fell at Melbourne, Victoria, on January 1, 1928; presented by Mr. E. J. Dunn.

Rare tantalum minerals and others recently described from Western Australia; exchanged.

An exceptionally fine group of Cassiterite crystals from Bolivia; purchased.

Two extremely fine specimens of Diopside crystals from the French Congo; purchased. Half the cost of the better specimen was met by Mr. F. N. Ashcroft.

A series of fluorspars from the iron mines of West Cumberland; purchased. The specimens show colourless, blue, and yellow cubes on hæmatite ore, and are small and as a rule quite inconspicuous. Very little is as yet known about them, but they must be taken into account in any theories dealing with the origin of the iron ores, and this, of course, has an important bearing on the finding of new ore-bodies.

A series of small crystals of diamond from African occurrences not previously represented in the collection, including pale yellow, opaque cubes and a clear, colourless octahedron from the Belgian Congo, a colourless octahedron from Tanganyika Territory, a green octahedron from Grossfontein, and five rounded crystals from Giblong, Liberia; purchased, except the last item, which is a gift from Mr. G. L. English.

Department of Botany.

Among the recent additions to the Herbarium are a large collection of plants made by Mr. A. J. Wilmott in Spain, and collections from Malta, Morocco, Ruwenzori, Cameroons, Kenya Colony, Gold Coast, Natal, Greenland, North America, West Indies, Paraguay, and the Argentine.

Many valuable specimens of the genus *Hieracium* have been purchased from the herbarium of the late Rev. J. Roffey.

Several collections of British mosses have been acquired, which add considerably to our knowledge of these plants.

BOOK NOTICES.

Animal Life of the Carlsbad Cavern. By VERNON BAILEY. Pp. xiii + 195, with 2 maps and 67 figures. (Baltimore: The Williams and Wilkins Company. London: Ballière, Tindall and Cox. 13s. 6d.)

THE third Monograph of the American Society of Mammalogists is entitled "Animal Life of the Carlsbad Cavern" by Vernon Bailey. This little volume is well worth reading, and will prove of interest and value to the student of

natural history. The author, after an opening chapter on the Carlsbad Cavern, proceeds to deal with the "Life Zones" of New Mexico and Texas and the fauna and flora of these regions; it is a matter for regret that more information is not given about the Cavern itself. From the brief account dealing with these caves it is apparent that they are some of the largest and most wonderful in existence.

The Carlsbad Cavern is situated in the Pecos River Valley of south-eastern New Mexico, being at the base of the Guadalupe Mountains, in the centre of the desert. The Cavern is the largest and most striking of the numerous caves in the area; some of the rooms are of enormous size, the largest of them measuring 450 ft. in width and 250 ft. in height. The lowest point of the cave floor is given as 700 ft. below the level of the entrance, and the various rooms and passages extend for many miles.

The Carlsbad Cavern has been famous for a number of years for its rich deposits of bat guano; it is stated that as much as 100,000 tons of this fertilizer has been procured from one of the caves. The guano, which is now practically exhausted and can no longer be worked at a profit, is formed from the droppings of the guano bat, the Mexican Free-tailed Bat (*Tadarida mexicana mexicana*). This is not the only species of bat found in the caves, but it so vastly outnumbers the others that the latter are negligible as regards guano production. These bats appear to use the Carlsbad Cavern as a wintering place in which to spend the winter in a state of torpor. In the late summer and autumn they gather at the cave in enormous numbers, so much so that it is stated that black streams of bats pouring out of the cave opening are visible at a distance of two miles.

The guano deposits resulting from the bats were formerly very extensive; it is reckoned that they were a quarter of a mile in length and up to a hundred feet in depth. At the present time there is very little guano left in the cave, and it cannot be a profit-making undertaking to work the guano for many years to come.

The chapter dealing with the "Life Zones" is of interest and is accompanied by a coloured map showing the four zones. Included in this chapter is a sketch-map of the Carlsbad Cavern itself, showing the plan, elevation, and cross-section of the caves. Then follows a chapter on the vegetation of the region, illustrated with some fine photographs of Yuccas and Agaves. Chapter V deals with the mammals of the region, special notice being given to those actually found inhabiting the Cavern. As in most American publications, we find the bison spoken of as the buffalo, and this, in spite of the scientific name being given as *Bison bison bison*; such is the perversity of mankind. There is, however, an excellent and curious photograph of a charging bison coming straight at the camera. The caribou is, of course, here spoken of as an elk, a name which we on this side of the water more sensibly reserve for the European elk or moose of America. This chapter on the mammalia and those following on birds and reptiles of the region make quite entertaining and interesting reading and are well illustrated.

The volume concludes with an account of the Invertebrates of the Cavern, which consist of a few species of insects, spiders, mites, millipedes, and scorpions. Two new crickets are mentioned as having been described from material found in the Cavern. It is noted that blue-bottles were found near the bottom of the east shaft, and the vexed question whither certain Diptera go in the winter-time is partly elucidated by the suggestion that these flies aestivate in the cool caverns during the heat of the summer, and in the winter remain in the open. The invertebrate fauna of the Carlsbad Cavern is stated to be very meagre compared with more open caves of the desert region. This is rather

surprising considering the number of parasitic mites and fleas that occur on so many species of bats. Possibly the guano bat is not so richly endowed in this respect as some of its near relations, or, more probably, the mites and fleas are there all right; in fact, their presence in small numbers is noted, but they are possibly too fond of their hosts to desert them, and only when a bat is captured are records of these parasites obtained.

Museums and National Life. By SIR FREDERIC GEORGE KENYON, G.B.E., K.C.B., F.B.A. Pp. 32. (Oxford: The Clarendon Press. 1927. 2s.)

THE Romanes Lecture was delivered at Oxford on the 17th June, 1927, by the Director of the British Museum, who is pre-eminently qualified to make such an attempt to justify the ways of those who devote their lives to the ordering and administration of those warehouses of science and learning known as museums. He traces the development of museums from collections formed at first merely to gratify the tastes of the collector, next serving the student by providing him with materials for research, and finally also serving the public as a means of recreation and an instrument of education, this last use having its beginning in the latter half of the nineteenth century as a response by the museums to the opportunity created by educational progress.

Sir Frederic Kenyon emphasizes the need of large collections for research. "The serious student, whether of Greek vases or of enamels, of fishes or of fleas, needs to compare a large number of specimens in order to formulate the necessary classification or to establish the characteristics of a species."

This very fine address should be read by all who desire to understand the work of museums as centres of research and education.

STAFF NEWS.

DR. F. A. BATHER, M.A., D.Sc., F.R.S., Keeper of Geology, retired from the service of the Trustees on February 17 after just over forty years of service.

Francis Arthur Bather, who was born on February 17, 1863, was educated at Winchester College, and at New College, Oxford, where he held a scholarship. He graduated with a first class in the school of Natural Science in 1886. He entered the service of the Trustees of the British Museum as Second Class Assistant (old style) in the Department of Geology on September 12, 1887. He became Assistant Keeper (old style) on April 23, 1902, and on the retirement of Sir Arthur Smith Woodward, F.R.S., succeeded to the Keepership of Geology on May 24, 1924. Before he became head of the Department Dr. Bather had been in charge of the following fossil groups:—Echinoderma, Arthropoda, Vermes, and for several years, Brachiopoda, and he is well known as an authority on these groups. He has further devoted great attention to Museum technique and has introduced into the Department improved methods

for the preparation, storage, and exhibition of specimens; in this connexion he has from time to time visited most of the principal museums in Europe and North America on the look-out for devices which might usefully be adopted at the British Museum. His scientific services were recognized by the Geological Society of London by the award of the Wollaston Fund in 1897 and the Lyell Medal in 1911, and he held the office of President from 1926-28,



Photograph by

Photopress.

FRANCIS ARTHUR BATHER, M.A., D.Sc., F.R.S., WHO RECENTLY RETIRED FROM
THE KEEPERSHIP OF GEOLOGY.

which office by a remarkable coincidence he vacated on the very day on which he retired from the Museum—his sixty-fifth birthday. He was President also of the Museums Association in 1903, and of the Geological Section of the British Association for the Advancement of Science in 1920, when his address, entitled "Fossils and Life," and giving his views on evolutionary problems, was recognized as a most important contribution to the advance of science.

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Vol. I

FIVE DAYS ON KILIMANJARO.

By R. KIRKPATRICK, formerly Assistant Keeper, Department of Zoology.

HAVING recently visited Kilimanjaro in the course of a tour in South and East Africa, I have been asked to give an account of my experiences on the mountain. Owing to the shortness of my visit, I have accepted the invitation with some reluctance, but nevertheless hope that these few notes may be not without interest.

Kilimanjaro is in Tanganyika Territory near the boundary with Kenya Colony, about 200 miles from the coast and 3 degrees south of the equator. The long axis of the mountain mass lies west-east. From a saddle-plateau, 15,000 feet above sea-level, there arise two peaks separated by the length of the plateau, about four to five miles. The western and higher peak, Kibo, which is the highest point of the African continent, reaches an altitude of 19,720 feet; its summit has a rounded outline and is covered with a perpetual ice-cap. The eastern peak, Mawenzi, which rises to an altitude of 17,570 feet, is crowned with rock pinnacles, too steep to support snow for long. The periphery of the mountain at its base is about sixty miles. The north side is steep and barren; the south-east side, on the other hand, benefits by the south-east monsoon and shows several well-marked zones of vegetation: namely, bush and cultivated zones at the base, a belt of virgin forest, grass-lands, and almost barren desert near the ice and snow.

Both Kibo and Mawenzi have craters. That of Kibo is magnificent and well defined, and measures about 600 feet in depth and 2000 yards in diameter. It was discovered only in the year 1889, when Hans Meyer and L. Purtscheller reached for the first time the rim and a little later the highest point, the Kaiserwilhelmspitze; from Moshi, *i.e.* from the south, no crater is visible. The crater of the blasted and weathered Mawenzi is not well defined. Joseph Thomson first pointed out that Mawenzi is the older peak, Kibo being the result of later eruptions.

The mountain slopes are inhabited by the Chagga people, a small branch of the Bantu family. The speech is Chagga, a Bantu language, but they also speak Swahili, the *lingua franca*

of East Africa. The population, numbering about 180,000, is divided up into about twenty little states, which are separated by mountain streams and ridges, each state being governed by its petty chief. Thirty years ago these states were constantly at war with one another, and were subject to raids by the Masai and Arab slave-dealers. In the works of H. H. Johnston and Hans Meyer much is written about Mandara, the "Sultan" of Moshi, a truculent and rapacious tyrant with an insatiable appetite for "presents," which he graciously accepted from explorers and others, who were then permitted to carry on their work, but precariously and subject to the tyrant's caprice. How great is the change now-a-days, when the tourist can travel rapidly by train or motor-car, and everywhere in reasonable comfort and safety, thanks to the fact that Europeans administer these great territories.

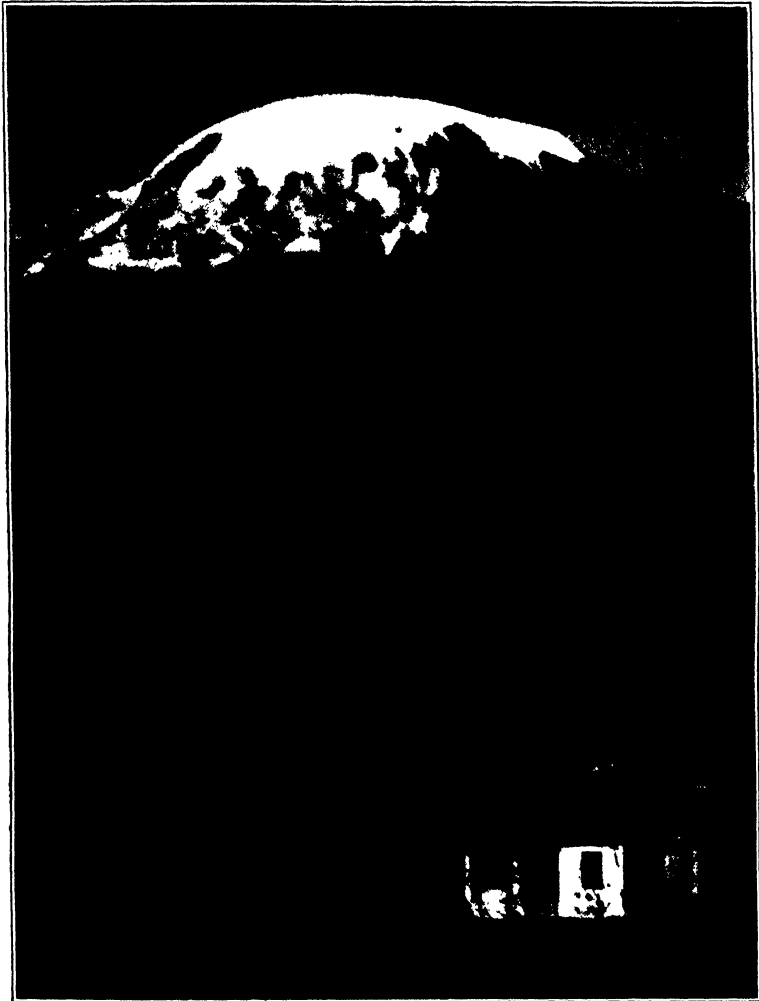
Many are the legends about Kilimanjaro. Mawenzi, living shattered under a cloud, is said to owe his misfortune to the impatient wrath of his younger brother, Kibo. When his pipe went out Mawenzi asked his brother for a light, which the latter gave: but when Mawenzi reiterated his request, Kibo attacked him furiously. Another version relates that Mawenzi's fire went out. On applying to his brother, Kibo, who was grinding dried bananas in a mortar, he received both fire and food; but on a second or third request Kibo lost his temper and smote his brother with a pestle. Certain curious agreements between geological fact and legendary fancy tend to the suggestion that the latter may be based upon some remote tradition of volcanic activity.

The Chaggas observe a certain etiquette in regard to their beloved Kilimanjaro. In ordinary social intercourse it is not polite to pass between the mountain and one's friends. Again, the dead are buried with the head towards the mountain. According to an Abyssinian legend the first king of Abyssinia, Menelik I, son of Solomon and the Queen of Sheba, is buried on the summit of Kibo with much treasure and the seal of Solomon on his finger. The king, it is said, was returning from an expedition of conquest of the territories of East Africa when, while in camp on the plateau of Kilimanjaro, he felt his end approaching. Accompanied by his war-lords and slaves, he ascended to the summit; when his war-lords returned to camp he was not with them. To this day Abyssinians regard Kenya and Tanganyika as parts of "Ethiopia," and believe that a king will arise who will remove Solomon's seal from the finger of Menelik and reconquer East Africa. Dr. R. Reusch,* of the German mission

* *Tanganyika Times*, January 7, 1928.

at Marangu, who has been three times to the summit of Kibo, says that some of his Abyssinian converts were incredulous when he told them that he had found no trace of either Menelik or his treasure.

The quickest way from London to Kilimanjaro is by the



Photograph by

Major A. E. Perkins, reproduced by permission.

FIG. 1.—KIBO, VIEWED FROM MOSHI.

The view reveals the stupendous height of the peak.

Suez Canal to Mombasa, the port of Kenya Colony. Here one can book to Moshi, changing at Voi from the Uganda Railway to the branch line to Moshi. I myself, however, came from the south and travelled back from Nairobi to Voi and Moshi. To

the new-comer it is fascinating to see from the train the numerous herds of wild game on the plains: zebras, several kinds of antelope, giraffes, ostriches, and so on. At the second station west of Voi is Tsavo, the scene of Major Paterson's famous book, "The Man-Eaters of Tsavo." In dry weather the red dust blowing into the carriages is trying, especially to some of the passengers. I saw a "White" terrier entrain at Mombasa and emerge a disreputable "Bolshevik" at Nairobi. To a visitor from England it is a novelty too to see the engines fuelled with wood.

On arrival at Moshi at the foot of the southern slopes of



Photograph by

Major A. E. Perkins, reproduced by permission.

FIG. 2.—KIBO, VIEWED FROM MOSHI.

The peak is swathed in storm-clouds.

Kilimanjaro I put up at the Kilimanjaro Hotel, then presided over by Major A. E. Perkins, who gave me much valuable advice about the requirements in food and equipment for climbing the mountain. I jotted down the chief items: one guide and ten porters; $1\frac{1}{2}$ lb. of rice and 2 oz. of ghee (clarified butter) per man per day; sugar, salt, etc. enough for six days; and one pair of blankets per man. All these goods were promptly procured in the various stores.

I had already enjoyed a distant view of Kilimanjaro from the train on my way from Mombasa to Nairobi; but at Moshi, which is only 2657 feet above sea-level, one sees the higher and western peak, Kibo, in all its imposing grandeur, towering upwards of 17,000 feet into the sky (Figs. 1 and 2).

Major Perkins gave me a letter of introduction to Mr. P. J. Sinclair, the owner of a coffee plantation at Marangu. On the morning of the 16th February, 1928, I hired a motor-lorry to convey me and my baggage to Marangu, which is about twenty-five miles east of Moshi and about 4500 feet above sea-level. The road, which passed between banana plantations a good deal of the way, was perhaps not too bad, although I felt some surprise that the lorry held together. At one place a river was crossed by means of a submerged causeway. In about two hours we came to a long avenue of trees bordering coffee planta-



FIG. 3.—CHAGGA PORTERS DISCUSSING TERMS.

tions, and presently reached Mr. Sinclair's bungalow with its garden bright with cannas and roses. It was pleasant to be greeted by two friendly dogs and later by their English master. He informed me that a retired Swedish officer, Capt. Möller, had started that very morning to ascend the mountain, and advised me to defer my climb until the day following in order to avoid two large parties clashing in the limited accommodation of the rest-huts. Mr. Sinclair added that in the meantime I was to be his guest and he would arrange for guide and porters. Soon a number of local men—Chaggas (Fig. 3)—assembled at the steps of the verandah, their spokesman being an intelligent man of the name of Gideon. At first both the leader and the men were unwilling to go, as their fields were in need of attention before the rains, and climbing to the cold heights is not popular

with them. When, however, they heard that the pay was to be one and a half shillings per day per man and that meat was to be provided, they became more amenable: "Ah," they said, "now we are talking to some purpose." The usual pay there is one shilling per day, quite a large sum in this paradise, where the cost of living figure is only a penny a day.

I called at the German mission with its pleasant garden and grove of trees. The ideal of the German missionaries, so one of them informed Hans Meyer, is: "Erst Zivilization, dann Christentum." Later I visited a beautiful waterfall in the



FIG. 4.—ON SAFARI.

course of a river, which here runs between high and steep, green banks and over great basalt boulders. In the deep pools I collected some river-crabs (*Thelphusa depressa* var. *Johnstoni*).

On the following morning (February 17) my party of twelve—Gideon, the guide, who had been brought up in a German mission and spoke German, ten Chagga porters, and myself—started at ten o'clock. The men were barefooted and carried the baggage on their heads (Fig. 4); this way of travel with porters is called "safari."* A servant, whom I had brought with me from Moshi, was sent back with a bottle of specimens, since the men objected to him as being tender-footed. Mr.

* An Italian lady at Nairobi, at whose request I conveyed a parcel to her friends at Moshi, wished me on my departure "good safari."

Sinclair lent me a climbing stick, about six feet in length and shod with an iron point.

At first the road lay between banana plantations belonging to the natives, their groups of round huts more or less concealed from view. I asked a small and nearly naked boy to get me some bananas. He disappeared into the plantation and returned with a dozen large green ones, for which I paid him sixpence. The plantations are irrigated by means of water drawn from the mountain streams. Herds of cows and goats may be seen grazing on the common land in charge of small children. Later the path lay between bush. It started to rain, and we hurried on until we came to the forest zone. Here we took shelter under large trees, but after a time, as there seemed no sign of abatement of the heavy downpour, we pushed on steadily along the narrow, ascending track, which now became in places a torrent. I was soon drenched to the skin, and my sodden shoes gave but little protection against stones and projecting roots. Worse than that, my rugs and blankets were exposed without waterproof covering on the carriers' heads. It was a great relief to emerge from the gloomy forest, and still more at about four o'clock to see in the distance the first rest-house—the Bismarck Hut (8000 feet).

The hut, although solidly built of stone, had a desolate appearance. Every window-pane was smashed, and it had no fixed door. There were three rooms with concrete flooring. The only furniture was a small table in the guests' room and a little dry grass for bedding; a few hooks on the walls would have been a boon. I suppose the difficulty is to prevent the theft of any article that a native might fancy. I changed into less wet clothes, and after a hot meal cooked by Gideon was glad to retire early to rest. A violent thunderstorm accompanied by torrents of rain came on during the night. While attempting to close some window-shutters to keep out the storm, Gideon cut his arm badly with broken glass. He came to me for first-aid, and after I had dressed the wound with antiseptics and bandages he retired with oft-repeated "*sehr danke schön.*"

Next morning (February 18) the sun shone bright and warm in a cloudless sky. All the wet blankets and clothes were rapidly dried in the hot sunshine. During the night I had fancied that I felt the hut shaking, and thought at the time that the heavy rain might have loosened the foundations. Round the sides and back of the hut I found abundant fresh elephant-spoor (circular pits made by their huge hoofs), also tracks and fresh dung in the jungle and forest. Possibly, terrified by the



FIG. 5.—VEGETATION ON THE MOUNTAINS OF EAST AFRICA AT ALTITUDES OF 10,000 TO 14,000 FEET.

1. Senecio Tree (*Senecio Johnstonii*, Oliver).
2. Lobelia Tree (*Lobelia Wollastonii*, E. G. Baker).
3. Heath Tree (*Erica arborea*, Linn.).

The original photograph, which was presented by Lord Rothschild, F.R.S., was taken on Ruwenzori by Mr. Alexander Barnes, who shot the large African Elephant now in the Central Hall. All three genera of plants occur also on Kilimanjaro, but the species of lobelia, *Lobelia Wollastonii*, has not yet been found on the latter mountain.

thunder and lightning, the elephants had sought what they usually avoid, the neighbourhood of man and his works. Great cataclysms of nature—forest or prairie fire, storm, flood, or earthquake—impose on the animal creation a truce of God. Possibly the shaking of the hut during the night might have been due to the proximity of the elephants. Had I but known of it, curiosity to behold so interesting a spectacle as that of wild elephants in a storm might have overcome my discretion.

In the bright sunshine and bracing air the fatigue and depression of the previous day were soon forgotten. Our way was at first through a forest of heath trees (*Erica arborea*), about fifteen feet in height and covered with white bloom (Fig. 5). Presently we emerged on to grass-lands. The view (from 10,000 feet) was widening. Below lay the forest belt, and still lower the plains with lakes and mountain ranges and the well-defined, pyramidal Meru about thirty miles to the south-west. Above, Kibo and Mawenzi showed over the edge of the saddle-plateau. At about 11,000 feet I was refreshed by seeing numerous specimens of the lobelia tree (*Lobelia Deckenii*) three to four feet in height; the gigantic, columnar inflorescence, rising from a basal tuft of large, oval leaves, is built up of close-set, pointed bracts in the axils of each of which is a pale-blue, stalked flower. At a height of over 11,000 feet I saw four senecio trees (*Senecio Johnstonii*), which, though trees, are plants related to our groundsel and all too common ragwort. The trees, which were about fifteen feet high, were by the side of a stream running through a ravine. The dark, woody, cylindrical trunks bifurcate once or twice, rather resembling pollarded trees, with tufts of bright green, oval-pointed leaves and bunches of yellow ragwort-like flowers among the tufts.

Mr. R. B. Woosnam * thinks that the lobelia and senecio trees, which are almost peculiar to the East African mountain flora of high altitudes, may live to a great age, the former to fifteen or twenty years and the latter to fifty or a hundred years. With the lobelia flowering involves the death of the plant.

We reached Peters Hut (12,000 feet) near the base of Mawenzi about three o'clock in the afternoon. This hut was better furnished than the one below, apparently because it is not worth while for predatory natives to come so far to steal. Next morning (February 19) we left the hut and proceeded on our

* "An Account of the Plants collected on Mt. Ruwenzori by Dr. A. G. Wollaston." By several authors. Third Tanganyika Expedition. *Journ. Linn. Soc., Botany*, 1908, vol. 38.

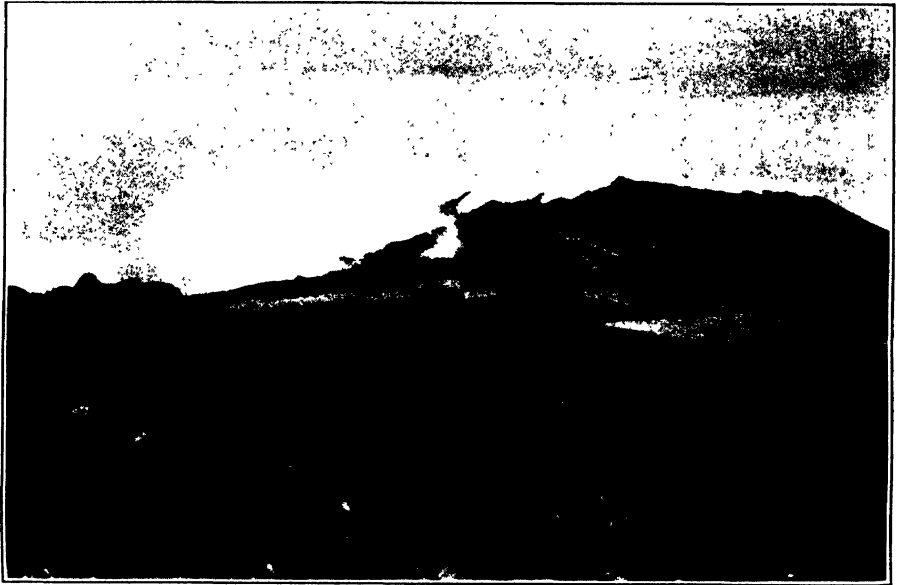


FIG. 6.—KIBO, VIEWED FROM THE SADDLE-PLATEAU (15,000 feet).

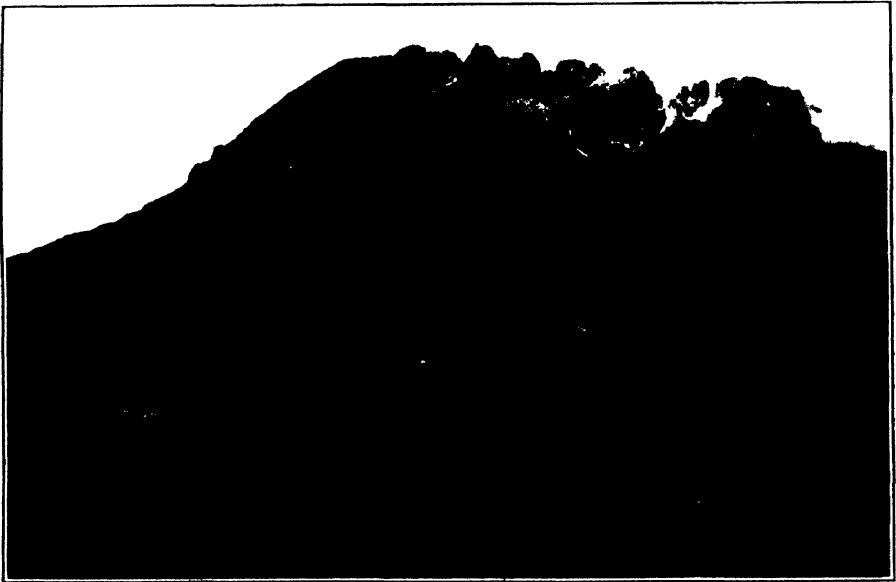


FIG. 7.—MAWENZI, VIEWED FROM THE SADDLE-PLATEAU (15,000 feet).

way. Above it the vegetation becomes poor and scanty, and at the edge of the plateau the Alpine desert is reached. Even on the plateau, however, there is enough vegetation to attract eland, as is evident from the spoor. It is supposed that the animals come up all the way from the plains and over the north edge of the plateau, there being no intervening belts of cultivated lands and forest. At last, on the plateau, one has an unobstructed view of Kibo (Fig. 6) with its perpetual ice-cap, and of Mawenzi (Fig. 7) with its crown of pinnacles.

Our procession trekked westwards across the plain to a great lava cave (15,400 feet) at the foot of the east face of Kibo (Fig. 8). On arriving at the cave we found Capt. Möller's porters squatting, huddled in their blankets (Fig. 9). About five o'clock Capt. Möller and his guide returned from, I believe, the highest point of Kibo, certainly from the crater. Both of them had suffered from mountain sickness. As Capt. Möller was over seventy years of age, it was a very plucky feat of endurance on his part to have attempted and to have achieved success. An Arab proverb has it: "Allah counteth not in the tale of a man's days those spent in hunting"; perhaps those occupied in climbing mountains are similarly exempt from reckoning.

During the night one of Capt. Möller's men was attacked by difficulty of breathing. I gave him an inhalation of steam and pine oil, and made him rub his chest with oil of wintergreen; but that draughty cave with twenty-two men in it was a terrible place in which to be ill.

Next morning (February 20) at seven o'clock I started with Gideon to climb to the crater and summit. We turned to the left and began to ascend a steep slope between projecting ridges. The going was difficult on the slippery volcanic screes. In about two hours we came to the edge of the ice-cap and followed its edge, which sloped upwards obliquely along the east face of Kibo towards the north. Fatigue was forgotten in admiring the green and blue tints of the glacier (Fig. 10) brought out by the vertical sun and the spectacle of Mawenzi opposite us with its pinnacles silhouetted against the eastern sky.

About two o'clock I began to suspect that Gideon had missed the way and had passed the notches (Johannes and Hans Meyer Scharte) through which lay the way to the crater. The clouds were boiling up from below, and as they reached us and the sky darkened, snow began to fall. We were at the foot of a vertical wall of ice (Fig. 11), over which it was impossible to get to the crater. Gideon began to wander to and fro in an aimless manner,



FIG. 8.
THE LAVA CAVE
AT THE FOOT OF
KIBO
(15,400 feet).



FIG. 9.—CHAGGA PORTERS OUTSIDE THE LAVA CAVE (15,400 feet).

and complained of a "sehr schlecht Kopfweh." He told me—though quite incorrectly—that Europeans had been lost just where we were. Evidently he was tired of his job. It was too late to begin searching for the right path; so I decided, but with great reluctance, to return to the cave. My compensated aneroid, which had recorded correctly at many known levels up to 15,000 feet, registered 19,400 feet at the moment when we turned back. This altitude was possibly wrong, but I had probably reached a higher point than Hans Meyer notch (18,600 feet). On my return home I submitted the aneroid to the



FIG. 10.—EDGE OF THE GLACIER ON KIBO (about 17,000 feet).

National Physical Observatory, and was informed that there was apt to be an error of 400 to 500 feet near the limits of the register of these instruments.

It may not be without interest to remark that I suffered in no way from mountain sickness. For the first time I tried a method of breathing taught by the Yogis, namely, the "complete breath," in which in one continuous movement the abdominal wall is first pushed out by contraction of the diaphragm, then the lower part of the chest, and lastly the upper part of it. Apparently by this means the chest-box is expanded to its full capacity, and a greater supply of oxygen is provided for the use of the increasing number of red blood-cells.* This method has been practised and taught by the Yogis from

* The altitude treatment for anæmia is based upon the increased formation of red blood-cells.

time immemorial. Further, I found on my return to the cave that the Yogi method of breathing seemed to have a tranquillizing effect on the circulation. On several occasions I had suffered discomfort from mountain sickness and difficulty of breathing at lower altitudes than the slopes of Kibo. Once I spent a night on the summit of Mont Blanc before the top fell in and destroyed the Shelter-hut and Observatory, and again only last year (1927) I spent a night near the summit of the Peak of Teneriffe. On both occasions I suffered from nausea and



FIG. 11.—ICE-CAP ON KIBO (about 19,000 feet).

dyspnœa (difficulty of breathing). Possibly I might have avoided this discomfort had I tried the complete breathing. I consulted a member of the second Mount Everest Expedition on the subject of breathing at high altitudes, and was informed that deep breathing was practised on Mount Everest but in the reverse order to that described above. Dr. D. V. Latham,* who ascended Kibo in July 1926 and made some very interesting physiological observations, adopts Kestner's theory, that "The

* "Kilimanjaro and Some Observations on the Physiology of High Altitudes in the Tropics," *Geographical Journal*, December 1926, p. 492.

effective factor of high climate is not diminished oxygen content, but the increased and more intense irradiation of the sun's rays. By the effect of rays substances are formed in the air which stimulate the formation of red blood-corpuscles if they [the substances] are inhaled." Increase in red blood-cells means not only additional oxygen-carrying material, but also increased respiratory surface (of blood discs), and deep breathing enables this surface to be reached more effectively. I suspect that mountain sickness may sometimes be due to imposing on a fatigued stomach an undue burden of unsuitable food. I am certain that I should not have escaped at Kibo had I indulged in a meal of tinned pork and beans.

Gideon and I descended the hard-won slopes at a rapid pace and reached the cave in about two hours. Having found a smooth, level place on which to sleep, I passed a comfortable night. We left at seven o'clock next morning (February 21), the men cagerly "heading" their burdens and starting off at a brisk pace. On arrival at Peters Hut we made the sad discovery that the sick man had died there, his body being in a covered lean-to near the hut. Although the men were hungry and had expected to stay for a meal, they now hurried on at once and continued the descent to the Bismarck Hut. Here I persuaded them, after they had had a meal, to go yet another stage to Marangu. They agreed to do so, "because I was a good man." Certainly they had had plenty of "skoff,"* good pay, and a fairly soft job. Accordingly we reached Marangu before dark. Mr. Sinclair emphasized the desirability of settling with the men without delay, and this he proceeded very helpfully to do. Through the kindness of a German lady on a neighbouring estate I was able to return at half-past four next morning (February 22) on a motor-lorry to Moshi, and arrived there in time to catch the early train to Mombasa and the mail-boat thence to Durban.

So ended my first visit to Kilimanjaro; but I do not propose to rest content with the partial success that I achieved, and expect to return to the mountain at the end of the year, when I shall make another attempt to reach the crater and summit of the mighty Kibo, an easy task, according to Dr. Latham who has done it, given fine weather and freedom from mountain sickness.

* While I was engaged in friendly conversation with a small boy of six or seven years of age on a tram outside Johannesburg a gang of convicts passed by. "Do they get paid for their work," he asked. "I don't think so," I replied. "But I suppose they get their skoff?" he queried.

ANTELOPES OF THE GENUS BOÖCERCUS.

By J. G. DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

THE Museum has recently received on loan from Major R. F. Cooper the mounted head of a Bongo from the Belgian Congo. This specimen has proved to be of unusual interest, differing in many respects from the other forms of Bongo.

Originally the Bongo was supposed to be confined to West Africa, but now the range is known to extend right across the equatorial forest area as far east as Kenya Colony; the species extends southwards as far as Katanga in the Belgian Congo. The typical race is from West Africa, being found in Liberia, Gaboon, and Sierra Leone; complete skins of this form were first brought to Europe by Paul du Chaillu, and for many years this Western Bongo was the only known form. In the year 1902, however, a Bongo was described from the Ravine Station, Kenya Colony, and was named by Mr. Oldfield Thomas *Boöcerus euryceros isaaci*. More recently Lord Rothschild named the Bongo from the Katanga Province of the Belgian Congo *Boi euryceros katanganus*.

Formerly the Bongo was considered to belong to the same genus as the Bushbucks; it is now, however, placed in a separate genus for which the name *Euryceros* was originally used by Dr. Gray, but which is now called *Boöcerus*. Bongos agree with the Elands in having horns in both sexes and in the tail being tufted; their horns, however, are more like those of the Nyala, being in the form of a smooth, open spiral. Further differences between Elands and Bongos are the absence of a dewlap and throat fringe in the latter animals. The ears are broad, and the short glossy coat is bright chestnut red in colour, with a white chevron marking on the forehead, a white crescent on the chest, and a series of white vertical stripes on the side of the body. The horns are sometimes extremely massive, the record horn length for the typical race being $37\frac{5}{8}$ inches along the front curve, 30 inches in a straight line, circumference 8 inches, tip to tip 9 inches; this specimen, however, is a female. Some of the male horns, although not of such great length, are heavier in build, some measuring as much as 12 inches in circumference. The horns of the Eastern race (*B. e. isaaci*) average a little longer, the record horn length for this race being $39\frac{1}{2}$ inches along the curve and $32\frac{5}{8}$ inches in a straight line. Some Bongo horns are very widely spread, the maximum tip to tip interval being as much as $21\frac{5}{8}$ inches in an Eastern specimen, and the minimum



BONGO FROM THE BELGIAN CONGO.

divergence being $3\frac{1}{2}$ inches (also an Eastern specimen). The horns of the Katanga race are shorter and proportionately much stouter, the typical specimen exhibiting the following dimensions: $28\frac{1}{2}$ inches along the front curve; 23 inches in a straight line; 11 inches in circumference; and $9\frac{1}{2}$ inches spread. This race is further distinguished by the fact that the face markings are almost the same shade of brown-red as the neck and fore-part of the body, whereas in the typical form and *B. e. isaaci* the face markings are black or dark brown, sharply contrasting with the red of the rest of the body; the type of *B. e. katanganus* comes from the Laurami District, Katanga, and is a mounted male specimen presented to the Museum by the Rowland Ward Trustees in 1927.

The Eastern race apparently enjoys a more limited distribution than the Western Bongo, being confined to the highland forest areas of Kenya Colony, from the Mau Escarpment to the Aberdare Mountains and Mount Kenya.

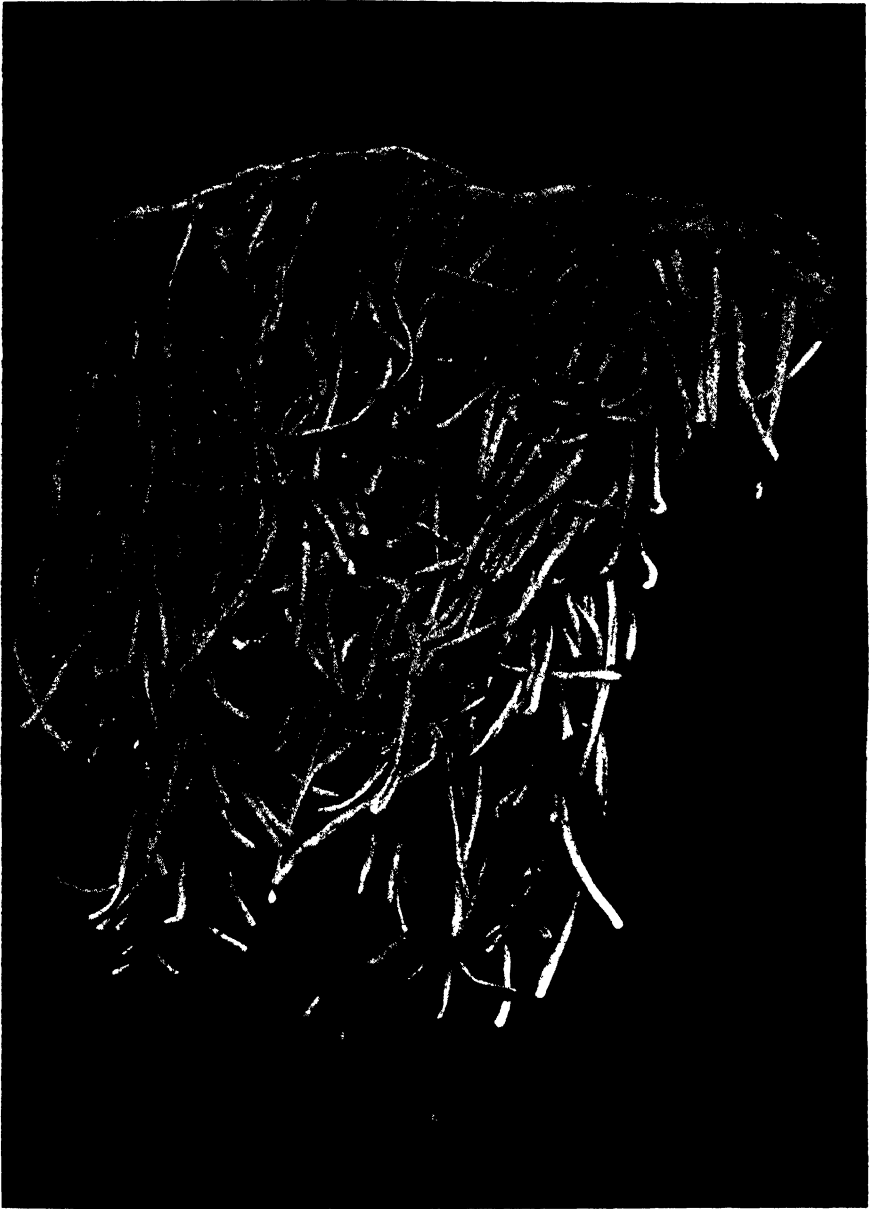
The Bongo lives in very dense forest, and for this reason comparatively few sportsmen have shot the animal; the majority of the specimens obtained being caught by natives in game pits and other traps. Their food appears to be fairly varied, and in addition to bamboo and other leaves they are reported to have a fondness for the bark of trees, sometimes uprooting small trees with their horns and stripping off the bark.

Major Cooper's Bongo, which comes from the Haut-Urle district of the Belgian Congo, is considered by Lord Rothschild to represent a form distinct from the other Eastern races, *isaaci* and *katanganus*. The specimen, which forms a valuable addition to the Collection, will shortly be placed on exhibition in the West Corridor.

HEAVY PARASITIC INFECTION IN WHALES.

By H. A. BAYLIS, M.A., D.Sc., Assistant Keeper, Department of Zoology.

THE Acanthocephalan parasite, *Bolbosoma capitatum* (v. Linstow), shown in the accompanying photograph was originally described from the False Killer (*Pseudorca crassidens*) in 1880, and has since been recorded from the Ca'ing Whale or Blackfish (*Globicephala*). The worm, in common with other species of the genus *Bolbosoma*, has a large bulbous swelling, armed with



Photograph (about one-half natural size) of a portion of the intestinal wall of a False Killer whale (*Pseudorca crassidens*) from Dornoch Firth, Ross-shire, showing crowded specimens of the Acanthocephalan worm, *Bolbosoma capitatum*.

hooks, at the anterior end, which is deeply buried in the wall of the host's intestine and forms a very firm attachment, rendering it difficult to dissect out without injury. As was mentioned in an article on "Parasites of Whales" in an earlier number of this Magazine (p. 55), "holdfasts" of this nature are developed by several parasites of whales, belonging not only to the *Acanthocephala* but also to the *Cestoda* and *Crustacea*.

Of the school of *Pseudorca* recently stranded in Dornoch Firth, every individual appears to have been infected with this parasite, which was usually present in such numbers as almost to block the intestine. In such an extreme case as that shown in the photograph the worms are attached so closely together that their bodies, hanging side by side, look almost as if they were enormous "villi" belonging to the intestinal wall itself. The whales were in very good condition, and seemed to be unaffected by this enormously heavy parasitic infection.

SOME MORE MIMETIC BEETLES.

By GILBERT J. ARROW, Assistant Keeper, Department of Entomology.

THE extent to which the principle of make-believe permeates living nature is not generally realized. Most animals and many plants try—unconsciously, of course—to appear to be other than what they are. The domestic tabby is decorated with light and dark stripes because its ancestors were similarly coloured in order to imitate the lights and shades of the boughs amongst which they hunted their prey. The humble donkey is coloured dark above and light beneath because as the result of this coloration his forbears appeared to be part of the plains over which they roamed. Indeed, the majority of mammals and very many other creatures show this arrangement on account of the concealment afforded by the effect of light falling from above on such a scheme of coloration; were the under side as dark as the back, the enhanced darkness of the former when in shadow would cause the resting animal to stand out conspicuously against the background, and would thus betray it to its enemies. Even certain flowers emit the odour of rotting carrion in order to lure to their doom the insects for which that odour suggests what is most to be desired; and

some of the fiercest of insects simulate the delicate tints and texture of flowers in order to entice flower-loving insects within their deadly grip.

The multitude of illustrations of the principle supplied by the insect world is practically endless. In the January number of this Magazine (pp. 166-172) a short account was given of a new exhibit in the Central Hall of the Museum illustrating Mimicry in Beetles. Most beetle mimics and their models, owing to their small size, are difficult to display to the best effect, and, on the other hand, many of them are apparently rare; thus the exhibit is only a small one, and may perhaps produce the impression that examples of mimicry in beetles are few in number. In reality very large numbers of beetles all over the world are affected by the phenomenon. Many striking instances have never been described, and a few more cases, of a different kind from those mentioned in the previous article, will probably be of interest to our readers.

In the islands of the Eastern Archipelago, and especially in the Philippine Islands, is found a remarkable group of weevils, most striking in their vivid colours and patterns and probably amongst the most indigestible of all insects, so extremely hard is their shelly exterior. Their movements are sluggish; they have lost the power of flight possessed by their ancestors, and their forewings, which in ordinary beetles form a pair of readily separable covers for the membranous hindwings and soft hind body, are solidified into an immovable capsule. Even the strongest pin will scarcely pierce any part of the body, and, although the insects are small, most of them not exceeding half an inch in length, it would take a considerable weight to crush them.

It might be supposed that insects of so little value as food would need no further protection from insectivorous animals; yet it is commonly found that such specially protected insects have the most conspicuous colours and patterns. The birds and other animals that feed upon insects must acquire their knowledge by experiment, and the more easily recognizable the subjects of their experiments the more rapidly and lastingly will the lesson be learnt. For those that are not good to eat this is very desirable, and it is evidently for that reason that these weevils, the most striking of which belong to the genus *Pachyrhynchus*, are distinguished by some of the most brilliant colours and most wonderful patterns to be found amongst insects. The surface of the body in all of them is smooth shiny black, brilliant green or fiery crimson, and upon it are arranged

bright-coloured scales by which the strange and beautiful patterns are produced. In *Pachyrhynchus gemmatus* the ground colour is crimson, and upon it are a dozen or more circular patches composed of glittering opalescent green scales surrounded by a ring of fiery red, producing a gorgeous effect which even jewels could scarcely imitate. *Pachyrhynchus regius* is decorated with pale green circles on a rich crimson background; *Pachyrhynchus reticulatus* has a curious network, sometimes of green and sometimes of red lines, on a black background, and others have scales of delicate tints in intricate patterns impossible to describe and unlike anything else known in nature.

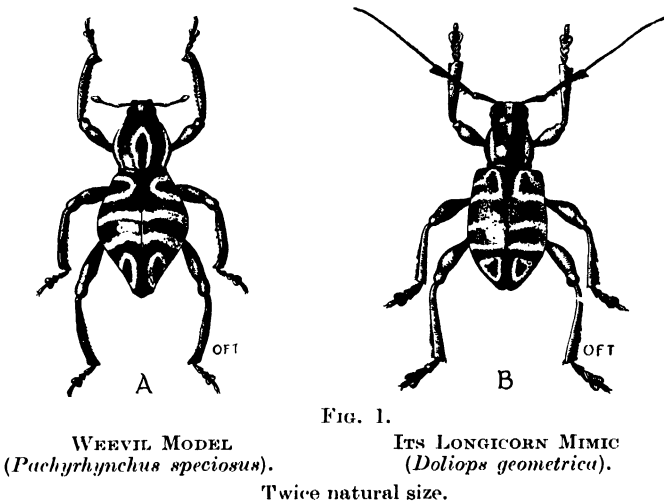
Occasionally, however, amongst a considerable number of one of these species a few specimens are detected which, in spite of a deceptive similarity in the pattern, are found to belong to quite another group of insects, without the stony quality for which, by the deception, they evidently gain credit. Amongst the Longicorn beetles, the group mentioned in the previous article as especially given to mimicking insects of other kinds, certain of those inhabiting the same islands and frequenting the same places as these weevils mimic with astonishing exactness their colours and patterns.

A large collection of *Pachyrhynchus* weevils was brought to England from the Philippine Islands about 1840 by a traveller, Hugh Cuming. A member of the British Museum staff at that time, G. R. Waterhouse, on studying them was surprised to find among a long series of one brightly spotted kind a single specimen of a Longicorn which exactly resembled it in colour and pattern. To this beetle he gave the name *Doliops curculionoides*, the latter word being intended to draw attention to the unexplained likeness to the member of the Curculionidæ (or Weevil family) with which it was found. This was many years before the significance of Mimicry was first pointed out by Bates in 1862. Since 1840 four more species of *Doliops* have been discovered, and each has the distinctive pattern of a different species of *Pachyrhynchus* in the company of which it lives, the weevils being many but the mimics apparently always few. The advantage to an edible insect of mingling with a crowd of inedible ones to which it bears a close resemblance is obvious.

One of the most beautiful of the weevils is *Pachyrhynchus orbifer*, which is adorned with scales of a beautiful, glistening pinkish hue, denuded in parts so as to leave bare upon the upper surface several black patches, which are outlined with a border of a lighter shade. Amongst a very large number of specimens

of this insect found upon a certain plant in the island of Luzon, a few examples of *Doliops imitator* were found, the Longicorn having similar pinkish-coloured scales, enclosing similar black patches outlined in the same way with lighter scales.

In the accompanying illustration (Fig. 1, A) is shown another *Pachyrhynchus*, *P. speciosus*, with a curious pattern of pale green lines upon a gleaming coppery surface, with which was found *Doliops geometrica* (Fig. 1, B), the Longicorn being adorned with the same brilliant and unusual colours and strange design, so far at least as its different bodily structure admits. It is unfortunate that the beautiful colours, which contribute so much to the close resemblance, cannot be shown here.



The most obvious difference between the Curculionidæ (Weevils) and Cerambycidæ (Longicorns) is that in the former the feelers (antennæ) are very short and clubbed at the end, whereas in the latter they are very long and tapering. In the five *Doliops* mimics this discrepancy is disguised, as the illustration shows, by a fringe of hairs forming a tuft which resembles the termination of the weevil-antenna, the remainder of the organ being so slender as not to be easily seen.

Other instances of mimicry occur in which both models and mimics belong to the vast weevil family, although the latter are only distantly related to the former. The mimic is without the protective hardness of the model, and as the consequence of the possession of well-developed wings is without the round-shouldered form characteristic of the flightless models. Most important, however, is the entirely

different head in the two groups. All weevils have the head produced into a snout, with the eyes near its base and the mouth at its extremity, but the section to which *Pachyrhynchus* belongs is peculiar because of the very short thick snout, as seen in the profile drawing (Fig. 4, A). In association with certain of the species there have occasionally been detected insects which, although at the first glance appearing identical, proved on examination to have a long, slender snout, generally tucked away beneath the body and therefore not immediately visible. These mimics belong to the genus *Alcides*, which is represented

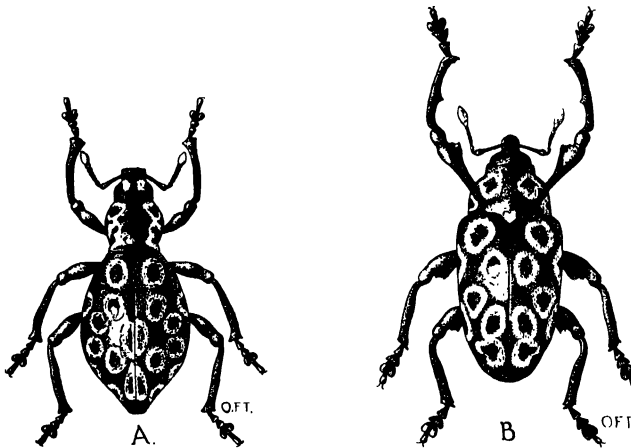


FIG. 2.

WEEVIL MODEL
(*Pachyrhynchus argus*).

WEEVIL MIMIC
(*Alcides semperi*).

Twice natural size.

by an enormous number of species, found throughout the Old World and almost always dull brown or more or less grey in colour. Many of these species have white scales, arranged in curious patterns which apparently serve the purpose of camouflage, producing false outlines which conceal the real shape. But in the islands in which the beautiful genus *Pachyrhynchus* is found, *Alcides* blossoms out into astonishing magnificence. A number of forms occur there, and there alone, with gorgeous colouring and curious designs, each unmistakably mimicking a particular species of *Pachyrhynchus* found in the same place.

A very beautiful species, *Pachyrhynchus argus* (Fig. 2, A), inhabiting the island of Luzon, has a pattern composed of small pale blue circles of different sizes covering most of its upper surface. With this has been found an *Alcides*, *A. semperi* (Fig. 2, B), decorated in exactly the same strange way with pale blue

circles. Another *Pachyrhynchus*, *P. congestus*, has roundish patches or discs of blue scales placed close together, and with this lives *Alcides schulzei*, which is ornamented with similar blue discs.

The Museum has recently acquired some specimens which illustrate another interesting case of the same kind. A German collector found in the greatest abundance in New Guinea a beetle of the hard-shelled *Pachyrhynchus* group, *Pantorhytes quadripustulatus*, an extremely conspicuous, shiny black insect with four raised golden-yellow spots, forming a square figure on its back (Fig. 3, A). He filled a bottle with about three thousand specimens and sent it to Berlin, where, in the

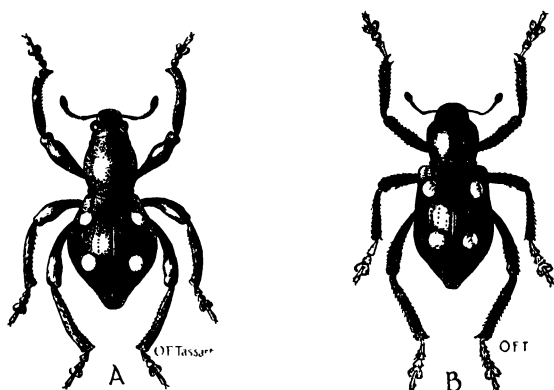


FIG. 3.

WEEVIL MODEL
(*Pantorhytes quadripustulatus*).

WEEVIL MIMIC
(*Autillia horridipes*).

Twice natural size.

course of an examination by an entomologist, a specimen was noticed which, instead of the round shoulders indicating that the insect is unable to fly, had square shoulders like most other beetles. Closer examination showed that, although size, colour and pattern were the same, this individual belonged to an entirely different group of weevils, having a very long snout concealed beneath the body (Fig. 4, B). A search for other examples of it resulted in the discovery of five more amongst the whole three thousand beetles, that is, a ratio of one to every five hundred of the common kind. One of the six specimens of this insect, to which the name *Autillia horridipes* has been given, has been presented by the Entomological Institute of Berlin to the British Museum (Natural History) together with specimens of the hard-shelled *Pantorhytes quadripustulatus*, with which it was found. To the naked eye the four golden

spots appear alike in both insects, but with the aid of a microscope it is seen that, whereas in *Pantorhytes* the spots consist of bright-coloured smooth elevations, in the mimic the same effect is obtained by four beautifully rounded cushions of silky golden hairs.

A great disproportion in the relative numbers of mimic and model is characteristic of such cases as I have mentioned. The more immune any insect is from attack the more abundant it is likely to be, and the greater the advantage to other insects, not so protected, in being mistaken for it; but such advantage is only obtained during a part of the imitator's life, since a considerable period is spent in the grub stage, under entirely different conditions and exposed to many risks of quite other kinds. The advantage to a quite palatable insect of being surrounded, during an important part of its life, by five hundred relatively

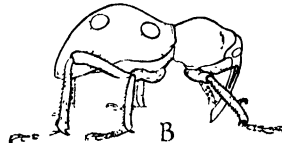
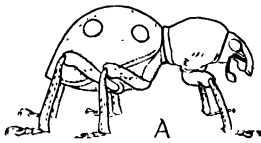


FIG. 4.

WEEVIL MODEL
(*Pantorhytes quadripustulatus*).

WEEVIL MIMIC
(*Autillia horridipes*).

Twice natural size.

unpalatable insects from which it is only with difficulty distinguishable will be easily realized.

There are other instances in which this disproportion in numbers is not found, and in which there may be no means of determining which is the model and which the mimic; in them we generally find that the associated insects are all noxious in a greater or less degree. This type of Mimicry is called Müllerian Mimicry from the naturalist, Fritz Müller, who first suggested its explanation. The Social Wasps of Great Britain, although of various species, are all alike in being conspicuously banded with transverse yellow stripes. This pattern becomes associated in our minds with the stinging powers of wasps generally, and the similarity of the different species renders it unnecessary for us to acquire experience of those powers in the case of each, all of them gaining the advantage of being treated with due respect. A similar colour scheme of alternating yellow or red and black bands is found widely prevalent in various other groups of insects known to be noxious, but in certain regions such banded insects do not occur and a different type

of pattern becomes indicative of noxiousness. There is no doubt that young birds and other insectivorous creatures, during the period when they are gaining their experience of the edibility of different insects, learn to associate a particular pattern with the quality of noxiousness, to the advantage of all that have acquired that pattern.

It is not unusual to find in one place insects belonging to a dozen or more diverse groups, which in their early life are utterly different in form, habits, and haunts, but which, congregating together in their adult stage, have all come to look superficially alike, not by reduction to a dull uniformity, but by assumption of the same peculiar shape, pattern, and striking coloration. Experiments have shown that all the abundant kinds which form the bulk of these mixed assemblies are protected by noxious qualities of one sort or another.

EXTINCT FLOWERING PLANTS AND THEIR LIVING ALLIES.

By W. N. EDWARDS, B.A., Assistant Keeper, Department of Geology.

IN the January number of this magazine (pp. 138–146), Mr. R. D'O. Good gave an account of recent botanical exploration in south-western China and the neighbouring mountainous regions, and pointed out that the results obtained have a "profound bearing upon many biological problems, and especially those of plant geography." We may consider here an aspect of the subject with which Mr. Good did not deal, namely, the resemblance of this Chinese flora to that of England ages before the advent of man.

The importance of the recent flora of south-west China for interpreting European fossils, as well as for understanding the historical aspect of plant geography, has recently been emphasized in a monograph published by the Trustees of the British Museum on some fossil plants from the Isle of Wight (E. M. Reid and M. E. J. Chandler, "The Bembridge Flora," 1926).

About the middle of the Cretaceous period the flowering plants, the origin of which is still, in Darwin's words, "an abominable mystery," spread rapidly over the whole globe and soon reached that dominant position in the flora of the world which they still hold, a dominance more complete than has yet been reached by any other plant group. In Upper Cretaceous

strata, and throughout the various divisions of the succeeding Tertiary beds, the remains of flowering plants occur abundantly; these relics are, however, very fragmentary, being usually only impressions of isolated leaves, or detached fruits and seeds. If one considers the vast number of living species of flowering plants (probably more than 150,000), and the frequent recurrence, in widely separated families, of similar leaf- or fruit-forms, it will be evident that the difficulties in identifying these fragmentary fossils are enormous.

The field of comparison can fortunately be limited in various ways. We may, for example, look for some region of the globe where these Tertiary plants, or their near representatives, still persist. Some are still to be found in Europe, but the region

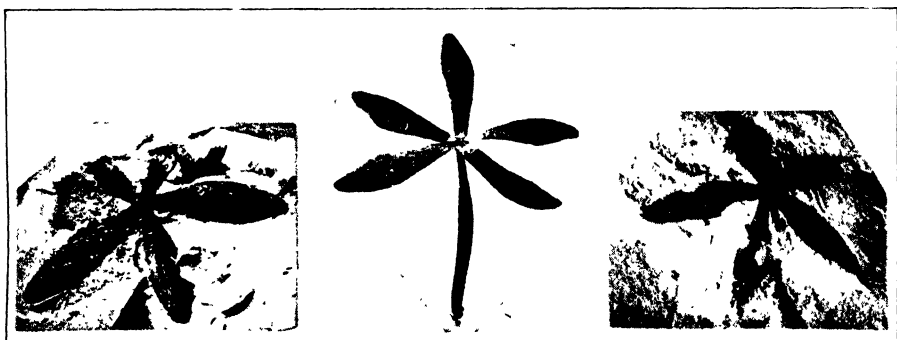


FIG. 1.—FRUITS OF A FOSSIL ABELIA ($\times 4$) FROM BEMBRIDGE IN THE ISLE OF WIGHT, AND (centre) A RECENT ABELIA ($\times 2$) FROM EASTERN ASIA.

which yields the greatest number of recent forms closely resembling the Tertiary flora is, as already suggested, that corner of eastern Asia which has only been explored by botanists in comparatively recent years. The geographical history of the northern hemisphere—the variations in land level, the building of mountains, the change of climate culminating in the Ice Age—explain this similarity. These and other factors combined to effect a slow but profound change in the vegetation of Europe.

Setting aside minor influences, the general outlines of this change may be summarized as follows. At the beginning of the Tertiary period the vegetation of a broad belt of Europe, North America, and northern Asia was fairly uniform, and almost subtropical. The climate, however, cooled gradually, so that when finally the Ice Age spread over the northern hemisphere, more and more plants were driven south. Meanwhile, mountain ranges had been uplifted in Europe—the Pyrenees, Alps, Balkans

and Caucasus—forming a barrier running from west to east, and continuing across Asia. These prevented further migration southward, and the plants found a refuge in eastern Asia. Thus it is that the rich flora of this region, and particularly of south-west China and Upper Burma, has such a close affinity to the past flora of Europe. Some of these east Asiatic survivals still live also in eastern North America. This is because in America the mountain ranges run mainly north and south, and did not bar the way to warm latitudes when glacial conditions prevailed; when subsequently the ice retreated and the climate improved,



FIG. 2.—LEAF OF A MAIDENHAIR TREE (*Ginkgo*) FROM TERTIARY ROCKS OF MULL, SCOTLAND.

the plants could again spread northward. In Europe, on the other hand, such north and south movement was blocked, and consequently the European flora of the present day is comparatively poor in species, although the climate is quite suitable to many other forms, which will grow freely if planted. If one looks through a nurseryman's catalogue of trees and shrubs one will find a whole group of plants, such as *Ginkgo*, *Abelia*, *Actinidia*, *Dipelta*, and *Koelreuteria*, all of which have been introduced into our gardens from eastern Asia and all of which lived in Europe during the Tertiary period.

An exhibit of fossil plants, found at Bembridge in the Isle of Wight, and described in the above-mentioned monograph,

has recently been arranged in Gallery X of the Geological Department (Centre-case M). Here numerous examples, chiefly impressions of seeds and fruits, show that tropical swamp-ferns, palms, gingers, cinnamons, and asclepiads grew in Oligocene times in the Isle of Wight, side by side with many warm-temperate plants of which the living allies are to be found in eastern Asia (Fig. 1). To these may be added a few examples from other Tertiary deposits. The well-known maidenhair tree (*Ginkgo*) (Fig. 2), which has had a long geological history, scarcely sur-



FIG. 3.—A NIPA SWAMP IN THE MALAY PENINSULA.

vives to-day in a wild state, and might have been extinct had it not been preserved in the temple-gardens of China. In Tertiary times it extended right across Europe and America, and fine specimens of the leaves have been found in the early Tertiary interbasaltic beds of Mull. *Ginkgo* survived in Europe up to the beginning of the Ice Age, and leaves from the Pliocene beds of Frankfort-on-Main are exhibited in the Fossil Plant Gallery. The tropical swamp-palm, *Nipa* (Fig. 3), is now confined to the coasts of eastern Asia and northern Australia, but its fruits have been found fossil in the United States, Europe, Africa, and Asia. They are abundant in the London Clay of Sheppey and the

Eocene sands of Bournemouth. The tulip tree (*Liriodendron*) is a Tertiary genus which has survived not only in China but in eastern North America. It has been found fossil in Holland as late as the Pliocene, and has been recorded from early Tertiary beds of southern England. Another example of a survival in eastern Asia and eastern America is the fern *Onoclea* from Mull, which is almost indistinguishable from the living *Onoclea sensibilis*.

Many other instances could be adduced, but enough has been said to show the intimate connexion between the present vegetation of eastern Asia and the past vegetation of our own country, at a time when the climate was almost tropical, and crocodiles and turtles basked in the mud of the Thames estuary.

A YOUNG SUMATRAN RHINOCEROS.

By J. G. DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

HIS Highness the Sultan of Perak has recently presented to the Trustees of the British Museum a young specimen of the Sumatran rhinoceros, *Rhinoceros (Dicerorhinus) sumatrensis*, which has been well mounted by the taxidermist of the Federated Malay States Museum. This young rhinoceros is of considerable interest, because it shows that the young of this species are quite as hairy as the adults.

The Sumatran rhinoceros is the only Asiatic species with two horns, both the Indian (*Rhinoceros unicornis*) and Javan (*Rhinoceros sondaicus*) rhinoceroses having only one horn. In this respect the Sumatran rhinoceros resembles the African species, but is distinguished from it by having teeth in the front of the jaw and by the presence of folds in the skin. These folds are, however, less pronounced than in the other two Asiatic species, the fold behind the shoulders being the only one to extend across the back. It is the smallest living rhinoceros, standing only 4 to 4½ ft. at the shoulder, and measuring about 8 ft. in length, excluding the tail. The females are considerably smaller than the males, the shoulder height being about 3 ft. 8 in.

In addition to being the smallest species it is also the most hairy, the body being rather sparsely clothed in brownish or black hair; in the present specimen the hair is black, but in an



YOUNG SUMATRAN RHINOCEROS

adult example on exhibition in the Lower Mammal Gallery the hair is reddish-brown in colour. The skin is granular, but not marked with the mosaic-like pattern met with in the Javan rhinoceros. This latter species, which is now almost extinct, shows no trace of the hairy coat of the Sumatran beast, either in the young or the adult stage.

The horns, which are comparatively slender, are separated at their bases by an interval, and the front horn curves backward; they are frequently of considerable size, the record horn, one in the Museum, measuring $32\frac{1}{2}$ in. in length and $17\frac{3}{8}$ in. round its base. Another specimen in the Museum Collection measures $27\frac{1}{8}$ in. in length and $17\frac{7}{8}$ in. in circumference. Rhinoceros horns are not, of course, composed of horn, but are formed of a mass of agglutinated hairy fibres; they are not firmly attached to the skull, and it is necessary to bolt or screw the horns on before exhibiting a specimen.

The Sumatran rhinoceros is found in Sumatra, Borneo, the Malay Peninsula, and northwards through Burma to Assam; it has also been recorded from Siam. The Assam rhinoceros has been separated as a distinct race on account of its more hairy ears, and has received the name *Rhinoceros sumatrensis lasiotis*. The Malay and Tenasserim form, to which the present specimen belongs, has also been distinguished from the typical Sumatran race, and should be known by the name *Rhinoceros sumatrensis blythi*.

The Javan rhinoceros (*Rhinoceros sondaicus*) is easily distinguished from the Sumatran animal by the presence of only one horn, the absence of hair on the body, and the mosaic-like pattern of the skin. The folds in the skin are much more pronounced. The single horn, which is frequently, if not invariably, absent in the female, is considerably smaller, the record horn, a specimen presented to the British Museum a few years ago by Mr. Marius Maxwell, measuring only $10\frac{3}{4}$ in. in length. In bodily size this animal is considerably larger than the Sumatran species, standing as high as 5 ft. 10 in. at the shoulder. It was at one time widely distributed, but is now nearly exterminated; formerly it ranged over a great part of Eastern Bengal to Assam and thence through Burma to the Malay Peninsula and islands. No local races have been so far distinguished, but it is quite probable that, if a number of specimens from the various localities could be examined, racial distinctions would be discovered.

The only other Asiatic rhinoceros is the Indian rhinoceros, a still larger animal, standing in some cases as much as 6 ft. 4 in. at the shoulder. It possesses a single horn and the skin on the

sides of the body is thickly studded with rounded tubercles. The record horn, also in the Museum Collection, measures 24 in. in length; this specimen is, however, quite exceptional, since as a general rule the horn of the Indian rhinoceros does not exceed about a foot in length, although a few specimens of 16 to 19½ in. have been recorded. At one time this species was distributed over a great part of Northern India, but is now-a-days restricted to Assam, Nepal, and some of the adjacent territories.

LARGE SPECIMENS OF SPAR FROM THE SNAILBEACH MINE, SHROPSHIRE.

By L. J. SPENCER, Sc.D., F.R.S., Keeper of Mineralogy.

THE Mineral Collection has recently been enriched by a set of fine specimens remarkable for their large size. Although the whole globe is made up of minerals, there is, of course, a limit to the size of specimens that can be usefully displayed in museums. We cannot bring a mountain to the Museum. The size of those collected underground is further limited by the widths of the tunnels and shafts constructed in mining operations. The miner working ores for their metal value has no use for large specimens of barren spar, and if hauled to the surface they come up as broken pieces of waste rock. Many cavities completely lined with beautiful sparkling crystals have been ruthlessly destroyed by miners. Only on very rare occasions has a mine manager been sufficiently interested in minerals as specimens (and disinterested commercially) to bring exceptionally fine and large pieces to the surface. Smaller pieces, such as usually find their way into collections, have mostly been brought up surreptitiously in the miners' pockets.

The question may be asked: what is the point of exhibiting specially large mineral specimens? It must be admitted that, beyond affording a spectacular display, there is not much point. Opportunities for seeing such specimens, however, occur only rarely, and unless they are preserved in museums they are lost for ever. Fine crystal-lined cavities are exceptional and are met with in but few mines. When freshly opened they present a wonderful spectacle in the torchlight; but they are soon broken down and the crystals become shattered and covered with dust from the blasting charges during the work under-

ground. When the gallery or mine is abandoned, the spot is no longer accessible, owing to flooding with water or to falling of the roof.

A small well-crystallized specimen examined under the microscope * is a very beautiful object and will often tell as much as, or perhaps even more than, a large specimen. A large specimen may, after all, show only a repetition of the same kind of crystals and grouping over a correspondingly larger area. This is the case with the slab of quartz crystals represented in Fig. 1, which might conceivably have extended even for miles. On the other hand, the specimen depicted in Fig. 2 shows very effectively the grouping of a smaller number of large crystals.

A collection to illustrate the size of crystals would have more meaning than one showing merely large specimens. Here we would be dealing with single individuals, which may vary very considerably in size. At the commencement of its growth a crystal is infinitely small, in fact of molecular dimensions; but, under favourable conditions, there would appear to be no limit to the size to which it may grow. There would, however, be many difficulties in the way to the formation of a collection of specially large crystals. The largest crystal of diamond yet found—the “Cullinan,” which weighed $1\frac{1}{3}$ lb.—had an enormous intrinsic value. The largest crystal of any on record is one of spodumene in the Black Hills of South Dakota: it measured 47 feet in length with a cross-section of 3 to 5 feet, and from it 90 tons of material was quarried for the manufacture of lithium salts. I have myself seen in a Canadian felspar quarry a crystal of felspar 20 feet in length, but unfortunately it was not possible to collect it. A mica crystal, 14 feet in length and 5 feet 4 inches in diameter, yielded 7 tons of fine mica selling at \$5 per pound at the mine in Canada. On the Museum almanac for 1928 we read of the acquisition of “an extraordinarily large crystal of sperrylite.” True, this is more than sixty thousand times as large as any sperrylite crystal previously in the collection or known to exist—but it measures barely an inch across. Sizes are merely relative.

The set of specimens from the Snailbeach mine was

* The late Mr. Clarence S. Bement, whose collection of large mineral specimens was purchased by Mr. J. Pierpont Morgan for presentation to the American Museum of Natural History in New York, afterwards devoted himself to forming a collection of microscopic mounts of minutely crystallized minerals; his reason for this, so he informed me, being that his flat in New York was much smaller than his mansion in Philadelphia, so small indeed that he even had to use condensed milk. Mr. Bement presented to the British Museum a specimen of bementite and a very fine group of rhodochrosite crystals from Colorado.

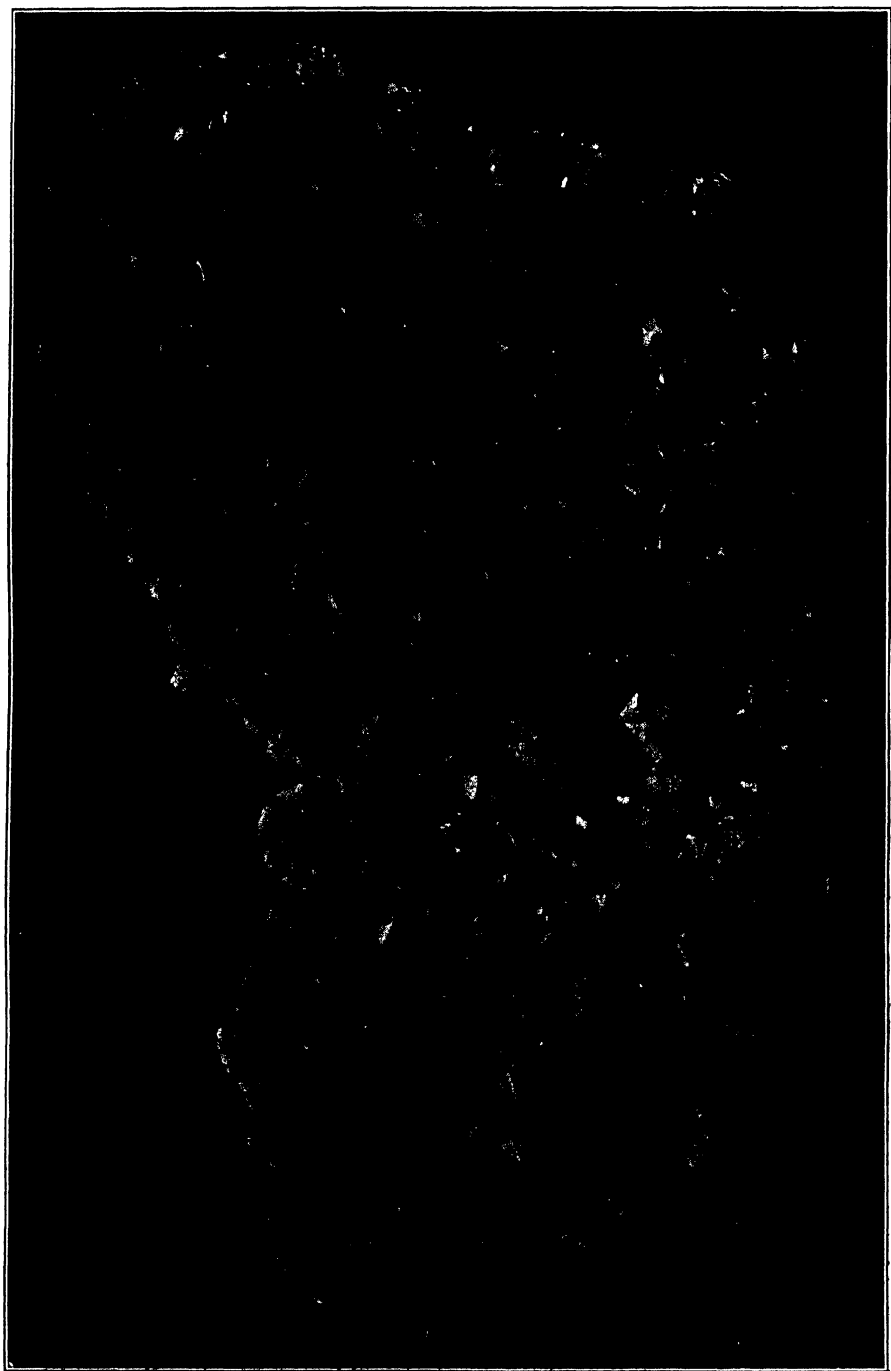


FIG. 1.—CRUST OF QUARTZ CRYSTALS ON BACKING OF CALCITE.
[Dimensions $5\frac{1}{4} \times 3\frac{1}{4}$ feet; weight 8 cwt. 73 lb.]

bequeathed by Mr. William Oldfield (1850–1928), who died on February 7, and who for the long period of thirty-eight years was the resident manager of the mine. He had formed a small collection of local minerals and had acquired others by exchange. The large pieces were set up separately on the terrace around his house. They were raised by him in 1894 from the 462-yard level and about 1899 from the 552-yard level. Having been exposed to the weather for over thirty years, they have, of course, lost their first freshness and brilliancy. When first raised, they must have been really magnificent specimens (and I blame myself for not having found them before). But fortunately the crystals had not been bruised and damaged by piling up the blocks to form a rockery or by building them into walls, as is so often done.

The seven specimens, which were transported by road to the Museum, have an aggregate weight of just over $23\frac{1}{2}$ cwt. The largest slab (Fig. 1) measures $5\frac{1}{2}$ by $3\frac{1}{2}$ feet and weighs 8 cwt. 73 lb.; it is broken into three pieces which fit together. It shows a crust of bipyramidal crystals of quartz, each about two inches across, on a backing of calcite. Between the quartz and the calcite are some small patches of galena.

Another specimen (Fig. 2) measuring 3 by $2\frac{1}{2}$ feet and weighing 3 cwt. 84 lb. shows a group of large crystals, up to ten inches across, of pale-lilac calcite. These crystals are interesting in showing the form of the primitive rhombohedron, the faces of which are parallel to the cleavage of calcite (this cleavage is well shown in a crystal at the top of the figure); and some of them are interpenetration twins on the basal plane. This habit and twinning is common in dolomite, but rare in calcite. The calcite crystals are in part encrusted with a layer of quartz crystals, while later still a few dark-brown crystals of zinc-blende were deposited on the quartz.

A third specimen, measuring 3 by $2\frac{1}{2}$ feet and weighing 3 cwt. 23 lb., shows well-shaped cubes of galena, measuring two inches along the edge, deposited on large (ten-inch) crystals of calcite. Here the calcite is almost white with a scalenohedral habit. The other specimens show just the same minerals, with in addition some small crystals of copper-pyrites (chalcopyrite). On all of them the order of deposition of the different minerals is always the same, namely, (1) calcite, (2) galena, (3) quartz, and (4) zinc-blende and copper-pyrites; but the different specimens show variations in the size and relative abundance of each kind of crystal.

The Snailbeach mine is situated two miles south-west of

Minsterley and twelve miles south-west of Shrewsbury. It has been worked for lead ore for very many years, perhaps by the ancient Britons. A pig of lead weighing 193 lb. and bearing the



FIG. 2.—GROUP OF LARGE RHOMBOHEDRA OF LILAC CALCITE PARTLY ENCRUSTED WITH QUARTZ CRYSTALS AND SOME ZINC-BLENDE.

[Dimensions $3 \times 2\frac{1}{2}$ feet; weight 3 cwt. 84 lb.]

impress of the Roman Emperor Hadrian (A.D. 117–38) was found on the Snailbeach farm close by in 1796 (or 1797) and was presented by John Lloyd to the British Museum in 1798, where

it may still be seen in the Department of British and Mediæval Antiquities. The ancient and more modern workings lie in a steep narrow valley down which runs a small rapid stream; and the name Snailbeach (in old books also Snailbatch and Snailbach) is perhaps a corruption of the German Schnellbach (quick stream). During the reign of Queen Elizabeth several German miners came to England, their fame having no doubt been spread by the publication in 1556 of Georg Agricola's great work "*De re metallica*." They have left their traces in some of the place-names of other mining districts; for example, Blagill (meaning lead gill) in Cumberland. Another German miner and adventurer who visited Snailbeach was the celebrated Rudolf Erich Raspe, F.R.S. (1737-94),* to whom is attributed the discovery at Snailbeach of the mineral minium (red-lead).†

Except for the working of barytes on a small scale in the upper levels, mining operations have recently ceased at Snailbeach and the place is now a desolation of ruined buildings and waste heaps. The waste heaps are being scratched over for pieces of spar (white calcite), which is crushed and graded for the rough-casting of walls and for garden paths. Enormous quantities of beautiful spar must at one time and another have been raised from the mine, and it is strange that there are so few specimens preserved in collections. (But this is evidently a result of keeping mineralogists tied to museums and not allowing them opportunities of seeing minerals as they actually occur in nature.) The long row of spar blocks forming the coping of the boundary wall of the Chapel at Snailbeach and the rockeries at Snailbeach farm and in the cottage gardens are eloquent, though now sad, relics.

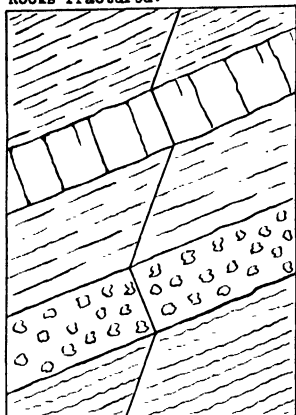
The word spar, and also Pliny's "*lapis specularis*," would at first suggest stones that sparkle; but it is more probably a corruption of the old German word *Spath*, later *Spat*, which suggests a stone that splits or cleaves into fragments with smooth surfaces. The forms *spath*, *spat*, *spaat*, *spato*, *espato*, *shpat*, etc. are used in most European languages, and in English we also have *spath* and the adjectival forms *spathose* and *spathic*. As a general term it is applied to a variety of minerals without metallic lustre which occur as crystals or cleave into

* Author of "*The Adventures of Baron Munchausen*" (1785), which was written while he was assay-master and storekeeper of the Dolcoath mine in Cornwall during 1782-88. He also figured as the villain in Sir Walter Scott's "*The Antiquary*" (1816).

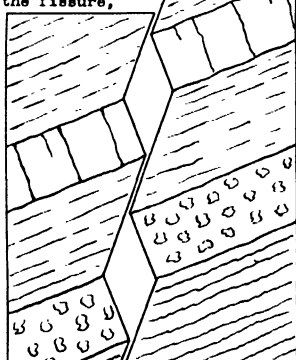
† A specimen of minium was given to me by Mr. William Oldfield in 1926, but he told me that it came from the bed of one of the old smelting furnaces.

fragments with bright surfaces. Such sparry minerals are well known to miners as the gangue of metallic ores or glances. Spar also comes into the names of several minerals; for example,

1st Earthquake
Rocks fractured.



2nd Earthquake -
The same shifted
("faulted") along
the fissure,



leaving cavities for
the reception of ore
and spar.

Hot springs rising in the fissure
carry mineral matter in
solution which is deposited in
the cavities.

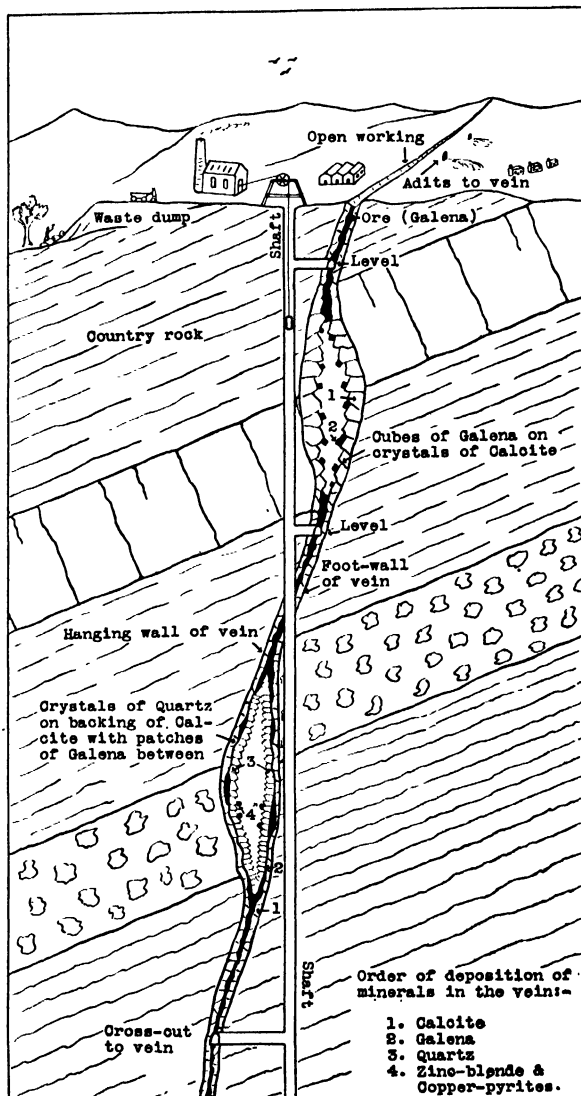


FIG. 3.—DIAGRAMATIC SECTION OF A MINERAL VEIN ALONG A FAULT FISSURE IN SEDIMENTARY ROCKS.

felspar (more correctly feldspar or field-spar), fluor-spar, calc-spar, Iceland-spar, satin-spar, heavy spar (barytes), adamantine spar (corundum), tabular spar (wollastonite), etc.

An attempt has been made to emphasize the sparkle idea in

the display of Mr. Oldfield's spar specimens. They have been set up in the large wall-cases in the dark corridor at the entrance to the Mineral Gallery; and with inside electric lighting ("lino-light") and a dark grey background a striking effect has been obtained. With these have been placed a few other smaller specimens from the same mining district in Shropshire. A specimen of the pale-lilac calcite crystals from the Snailbeach mine was presented by Mr. Oldfield in 1926, and having previously been kept in the mine office it had not been spoilt by exposure to the weather. Two other brilliant calcites from Minsterley were purchased for the collection in 1866. In addition, there are some masses of platy crystals of white barytes from the neighbouring Huglith mine, which is now the largest producer of barytes in the country. After being exhibited at the British Industries Fair last year these were presented to the Museum by the Malehurst Barytes Company.

The exhibit of these specimens is accompanied by a diagram to illustrate the mode of occurrence of the minerals and the formation of mineral veins. A reproduction of this diagram is given in Fig. 3, and is perhaps sufficiently explained in this place by the inscriptions.

THE TRAGEDY OF BRITAIN'S RAREST MOTH.

By HERBERT STRINGER, Clerk, Department of Entomology.

ONE fine June day in 1829, all but a century ago, a small moth of foreign appearance was captured in some numbers on Kersal Moor, Manchester, by a local entomologist named Robert Cribb. The collector, finding that the insect was new to entomologists in the district, gave a specimen to R. Wood to send to John Curtis to be named. Cribb also presented a pair to Samuel Carter, and one of this pair has recently come into the possession of the British Museum. This moth, now known as *Schiffermulleria woodiella* Curtis, has never been met with again in any part of the world.

Cribb, so far as can be ascertained, collected from fifty to sixty specimens, although the exact number is open to doubt, and, on Curtis naming the insect after Wood, became so angry that nothing would induce him to part with further examples. Having no foreign insects in his collection, Cribb naturally felt still more aggrieved when it was asserted in various quarters that

the species was a foreign one. The place where he said he took the moth was an old rotten tree, probably alder, growing not far from the path on the Manchester side of Kersal Moor.



Schiffermulleria woodiella CURTIS.

Photographed from Curtis's original figure of the type.

Twice natural size.

Whether or not as an indirect result of this attack on his veracity, Cribb gave way to intemperance and ceased to collect. It is evident that when not sober he was often tempted to part with his box of *woodiella*, and one day Carter actually offered him ten shillings for the box. Cribb promised him that he should have it if he would give him five shillings to get it from the beer-house which he was in the habit of frequenting, the other five shillings to be paid on the receipt of the box; this was agreed to, but Cribb subsequently disappeared and was not seen again for weeks. Some time later, however, Cribb and Carter met. High words passed between them, and then Carter, who was most anxious to obtain the specimens, said he would give Cribb ten shillings and pay the money which he owed as well. Thereupon they went together to the beer-house, where to their distress they found that the landlady had burnt the box, since Cribb had never come to pay his score as he had promised.

That was the end of *woodiella*, except the type specimen, from which the original drawing was made, and the two examples given to Carter. The first is now in the Melbourne Museum, Australia, and of Carter's specimens, the one is in the Manchester Museum and the other in the British Museum.

The historic spot where this species was taken has been visited many times since then, and an unsuccessful search was recently made on the old decayed stumps of alder alongside the Singleton Brook, which bisects Kersal Moor. That the species will ever be met with again after so long an interval is extremely unlikely; but should it be found once more there is little fear that the specimens will experience so ignominious an end as being burned in the kitchen fire of a public-house.

RECENT IMPORTANT ACQUISITIONS.

Department of Zoology.

A SELECTION from the magnificent collection of mammals shot in the Cameroons and Lake Chad district by the donor, Major P. H. G. Powell-Cotton. This series of specimens is of great scientific importance, as it contains the co-types of several new forms, including a new Kudu, which it is proposed to name in honour of the donor. This animal is smaller than the Eastern Kudu and has smaller horns; its discovery extends the range of the species many hundreds of miles in a westerly direction. In addition to these co-types there are also some fine specimens of the Western Giraffe (*Giraffa camelopardalis peralta*) and of the Congo race of Lord Derby's Eland (*Taurotragus derbianus congolanus*). The collection is one of the most important additions to the study series of Ungulates and Primates that has been received in recent years.

A large part of the scientific collections of the late Mr. J. J. Lister, F.R.S.; presented by Mrs. Lister. This includes 700 microscopic preparations of Foraminifera, together with a series of notebooks relating to them, being the material on which Mr. Lister's well-known researches on the reproduction of the Foraminifera were based; also a collection of 476 bird skins made by Mr. Lister in the course of his travels in Africa, the Indian Ocean, New Zealand, and Australia.

A White Whale or Beluga from Greenland, together with the heads and flippers of three other individuals; presented by the Government of Greenland. This extremely valuable material was collected specially for the Museum by the Danish Administration, preserved in salt, shipped to Copenhagen and thence to London. On arrival at the Museum the whale was found to be in perfect condition. A plaster cast of the entire animal, a male measuring 12 feet 6 inches in length and weighing about a ton, has been made, and this will in due course supersede the old imperfect model of the Beluga which for many years has been exhibited in the gallery. Dissections of the whale are in progress, and the skeleton when cleaned will form an important addition to the collection. The Beluga is a species of economic importance confined to the Arctic and sub-Arctic seas. It is hunted in the Greenland seas for the sake of its blubber and for its remarkably tough hide, used in the manufacture of boot-laces.

A valuable collection of Antelopes; presented by Mr. R. Akroyd, who some months ago visited the Imatong Hills of the Mongalla district on a shooting expedition. The chief object of the expedition was to obtain specimens of the Giant Bushbuck (*Tragelaphus barkeri*), an antelope only recently described by Mr. J. G. Millais. In addition to specimens collected for his own museum, Mr. Akroyd was able to procure for the British Museum two whole specimens of this rare antelope, a skin, and two skulls. The collection also contains specimens of Roan Antelope, Hartebeest, Tiang, Reedbuck, White-eared Kob, Mongalla Gazelle, and Duiker. It is proposed to have one of these very handsome Bushbucks mounted for exhibition.

Seven specimens of the Giant Ship Worm (*Kuphus arenarius*) from the Solomon Islands; presented by Mr. D. Holderness, Engineer to the Harbour Board, Auckland, New Zealand. The specimens were obtained for the Museum by Capt. Burgess, of the Mission steamer "Southern Cross," after several years of search and inquiry among the natives. They are the first specimens of the soft parts of the animal that have been seen by any naturalist since the time of Rumphius, more than two centuries ago.

The skin and skull of a Swedish Wolf; received in exchange from the Stockholm Museum. This is an important accession, since the Wolf is now nearly extinct in Sweden and the Museum has not hitherto had a specimen from northern Europe.

108 specimens of birds from a region in Senegal previously ill-represented in the Museum collection; purchased.

A collection of Crustacea, Arachnida, Myriopoda, Peripatus, and Mollusca from Colombia, including examples of 27 new species; purchased.

An important collection formed by Prof. P. Fauvel, comprising 900 specimens (representing about 400 species) of Polychaet worms from European waters; purchased.

Two exceptionally fine Rhinoceros horns from the Tana River district, East Africa; purchased. One horn is of unusual shape and size, having a double curve and measuring $49\frac{1}{2}$ inches in length.

Department of Entomology.

The Eustace Ralph Bankes collection of British Lepidoptera; presented by Mrs. Grace Bankes. This collection includes upwards of 96,500 specimens, and is contained in three 40-drawer cabinets, besides smaller cabinets and store-boxes. As regards the number of specimens and varieties of the different species represented, it is by far the richest ever presented to the Museum. In addition to many striking aberrations it comprises long series of bred specimens and others purchased at sales of various well-known collections, and the excellence of the condition of the tiny moths of the families Tortricidæ and Tineidæ, among which are several type specimens, is an especially noteworthy feature.

Some remarkable cocoons of beetles; presented by Mr. Arthur Lee, Entomologist to the South Australian Museum. These solid calcareous objects, many of them larger than a fowl's egg, are found plentifully along the sea-coast of South Australia and for about forty miles inland, and Australian naturalists have long been puzzled as to their origin. It has recently been discovered that they are the abandoned cocoons of beetles, which have become filled with sand and subsequently solidified by the infiltration of lime in solution.

The Piaget collection of Mallophaga and Anoplura (bird and mammal lice), consisting of 2150 microscopical preparations, which include the types of upwards of 330 species; purchased. With this collection the Museum has also secured all the original drawings for the 70 beautiful plates in "*Les Pédiculines*," Piaget's well-known monograph on these insects, published at Leyden, 1880-85.

Department of Geology.

A valuable collection of fossil invertebrates from Oman in eastern Arabia; presented by Mr. G. M. Lees on behalf of the Anglo-Persian Oil Company.

New species of Upper Cretaceous crinoids from England; presented by Mr. R. M. Brydone, F.G.S.

Various invertebrates from the Gault of Osmington, Dorset; presented by Lieut.-Col. R. H. Cunningham, R.E.

A new genus of Carboniferous coral, collected by the donor, Dr. Louis Smyth, and to be described by him.

Lias brachiopods and molluscs from Watchet and Charmouth; presented by Mr. A. W. Coysh.

A Pleistocene marsupial from Queensland; presented by Mr. D. G. Barrymore.

A very fine example of the fossil fish *Lepidotus elvensis* (Blainville), from the Upper Lias of Holzmaden, Würtemberg; purchased. The specimen

measures $2\frac{1}{2}$ feet in length and is complete save for the tip of the lower lobe of the tail. The stout, coarsely-ornamented bones of the head and the thick, enamelled scales, typical of these "Ganoid" fishes, are in a brilliant state of preservation.

Permian plants, fishes, and amphibia from Germany; purchased.

Ammonites from the Gault of Sussex and Kent; purchased.

A very rare ammonite from the Cretaceous of Pinney Bay, South Devon; purchased.

Department of Mineralogy.

A typical specimen of tarbuttite, a zinc phosphate known only from the Broken Hill mines in Northern Rhodesia; presented by Her Highness Princess Marie Louise, G.B.E.

Small colourless tetrahedra of the rare mineral zunyite (previously known only from the Zuñy mine in Colorado), associated with crystals of diaspore from a new occurrence in South Africa; presented by the Director of the Geological Survey of the Union of South Africa.

An attractive group of snow-white, coralloidal aragonite ("flos ferri") from Arkengarthdale, Yorkshire; presented by Dr. L. J. Spencer, F.R.S.

A set of minerals from the pegmatite quarries at Newry, Maine, U.S.A., which are being worked for pollucite; purchased. This mineral contains 34 per cent. of caesium oxide and is the richest known source of this alkali metal, which now finds an application in the construction of thermionic valves.

Rare minerals from Mt. Vesuvius; purchased. These include baddeleyite (native zirconia) and a double chloride of copper and potassium recently named mitscherlichite after the German chemist Mitscherlich, who prepared this salt artificially in 1840. It has not hitherto been observed in nature.

A large, well-formed crystal of iron-pyrites from the island of Elba, Italy, bounded by facets on all sides and measuring $4\frac{1}{2}$ inches across, its weight being nearly 6 lb.; purchased.

Department of Botany.

A series of tracings of the original drawings of Hepaticæ (Liverworts) by the late Franz Stephani; purchased. Stephani devoted many years to the study of this group, on which he published an exhaustive monograph (1899–1925). The drawings made by him during the course of his work are valuable as illustrating the structure of these minute plants, the species of which are very difficult to discriminate. The tracings are the work of his daughter, Fräulein Johanna Stephani.

A considerable collection of plants from Morocco, made by Dr. Font Quer, of Barcelona, during his journey of botanical exploration in 1927; purchased.

500 specimens of plants from the British Cameroons, collected by Mr. F. W. H. Migeod; purchased.

General Library.

Four interesting books from Horace Walpole's library at Strawberry Hill, with his book-plate and his manuscript notes and corrections; viz. Thomas Pennant's "A Tour in Scotland, 1769–72," Warrington, etc., 1774–76; and Charles Cordiner's "Antiquities and Scenery of the North of Scotland," London, 1780; presented by Mr. B. H. Soulsby. In the former Pennant ascribed a portrait to the Countess of Desmond. Walpole has corrected this in a letter to the Rev. William Cole, in which he says: "Among others is the vulgar head, called the Countess of Desmond. I told him I had discovered, and proved past contradiction, that it is Rembrandt's mother. He owned it and said he would correct it by a note—but he has not. This is a brave way of being an antiquary!"

BOOK NOTICES.

Animal Biology. By J. B. S. HALDANE and JULIAN HUXLEY. Pp. xvi + 344, with 122 illustrations. (London : Oxford University Press. 10s.; cheap edition, 6s. 6d.)

IN this book a general account of the organisation, physiology, and development of the frog is followed by chapters on the nervous system, organic regulation, the internal environment, etc., forming a well-written and up-to-date introduction to animal physiology, in which the importance of the coordination effected by the nervous system and by internal secretions is emphasized. The concluding chapters on the methods, processes, and results of evolution are interesting, but less convincing. With regard to methods the authors dismiss Lamarckism and accept the natural selection of mutations, which are defined in one place as variations that can be inherited, and in another as slight changes in the factors, inherited in Mendelian fashion. The factors or genes are described as self-reproducing units, presumably of a chemical nature, occupying definite positions in the chromosomes. This solution will not fully satisfy those students of evolution who are acquainted with the complexity of the problem. The chapter on processes of evolution deals with adaptation, the relation of the animal to its environment, etc. The origin of terrestrial vertebrates is treated thus : great competition existed among vertebrates in the sea, but not yet on the land ; hence it would be a biological advantage to any species if it were to vary in such a way as to make it able to live on land. This is not very illuminating, for there can be little doubt that the Devonian Rhipidistia, the ancestors of the four-footed vertebrates, were fresh-water fishes ; they probably took to air-breathing and developed an air-breathing organ because of a deficiency of oxygen in the water, as several modern fishes have done, *e.g.* the Clariidæ and Anabantidæ, which often leave the water. It is not the occurrence of a variation, but the change of habits and consequent change of structure, that appears to have determined the evolution of land animals from fishes.

The authors estimate that about half a million species of animals have been described and named, but when they say that about 200 new species are added each year, we suspect that this is a slip and that 2000 should have been the figure. During the last thirty years the annual average of new species of fishes alone is probably about 200, and of Coleoptera perhaps several times that number.

Wild Animal Pets. By WILLIAM L. and IRENE FINLEY. Pp. xiv + 311, with frontispiece and 71 illustrations. 1928. (London and New York : Charles Scribner's Sons.)

"Wild Animal Pets," by Mr. and Mrs. Finley, is a little book well worth reading, and many of the photographs which illustrate the volume are of considerable interest. It is written in a bright and breezy manner, and, although the work is dedicated to the author's children, grown-ups will find it quite entertaining, and, at times, instructive. Mr. Finley's long service as State biologist and Game Warden of the State of Oregon brought him into intimate contact with many and various beasts.

The book opens with a chapter on bears, chiefly about the black bears of

Yellowstone Park; it is interesting to learn that if one wants to be certain of meeting Mr. and Mrs. Bruin, the hotel dustbins are the most likely places to find them. The bears come there after such scraps of food as they can find, and being very omnivorous animals, they can, no doubt, frequently make a really square meal. Around the Lake Hotel the authors on one occasion saw no fewer than fourteen black bears industriously eating away at the hotel refuse. When a couple of grizzlies appeared on the scene the black bears beat a hasty and undignified retreat; the grizzly appears to be lord and master of its black cousin, and to have things very much all its own way. A wild bear in the woods is stated never to be dangerous if a person minds his own business; an instance is given of a misguided tourist offering an old she-bear a lighted cigar, with the result that the said tourist "got badly mussed up for the insult." A wounded or cornered bear, or female with cubs, must be regarded with a certain amount of respect; trying to reason or sympathize with a worried mother bear is much like "creeping up to find out why a charge of dynamite doesn't explode." When talking of the black bear's hibernating habits, the long winter sleep of Mrs. Bruin (which terminates in the birth of her cubs) is somewhat humorously referred to as "her twilight sleep."

Then comes a chapter on "Panthers," or rather, as we should say, "Pumas." It is a little surprising in one paragraph to find one and the same animal spoken of as a "cougar," a "mountain-lion," and a "lion." Elsewhere in the same chapter we meet with "panthers" and "pumas," and when one reads that "The lion was perhaps never really abundant, but was found in all the wilder sections of America, from Canada to Patagonia. It has never been a danger to man like the lions of Africa and India," one is forced to the conclusion that the authors really do consider this beast of many names as something to do with the lion of the Old World. Why these two animals, which are now thought to represent two distinct genera, should be so bracketed together it is a little difficult to understand. The same sort of thing is met with to a lesser degree in the chapter on the Pronghorn, which is characteristically referred to as an "antelope," which, of course, it isn't. The photograph of the Puma up a snow-clad cedar tree is of exceptional interest, as are those of the Puma cubs, which show the juvenile coat of these animals to advantage. The gradual but sure extermination of the Puma is rightly deplored; it is remarked that it is "going down before a great campaign of expert hunters, dogs, guns, strychnine, and steel traps."

The chapter on "Dinty"—the Porcupine—is one of the most entertaining; Dinty began life in a somewhat novel manner, having been ushered into the world through a Cæsarian operation performed with a pocket-knife on the body of its dead mother. Dinty only had one meal a day, but it lasted from daylight to nightfall! The photographs of this section are some of the most charming of the whole collection, especially the one of Dinty whispering in Peter's ear, Peter being a small canine friend. Reference is made to the damage porcupines can do to leather goods, a first-class saddle being rendered useless in a single night's depredations! The old-time fairy tale of how a porcupine shoots his quills is once again exposed, and instances are given of the damage caused by quills to the large carnivora; there is a case on record of a lioness (a real one) getting its face stuck full of these weapons and going quite blind.

The Coati Mundi illustrations are excellent, as are those of the Chipmunk found on the top of Mount Rainier.

Three chapters are devoted to birds, a Californian Quail, a family party of Condors, and Gulls. Among other interesting items is a tale about the Wood-pussy or Skunk, and another concerning the Moose. It is interesting to hear that there are between 400-600 head of Moose in Yellowstone Park.

The Origin of Instinct : a Study of the War between the Ants and the Termites. By PROF. E. BUGNION. *Psyche Monographs* : No. 1. Pp. 44, with 8 plates. 1928. (London : Kegan Paul, Trench, Trübner & Co., Ltd. 5s.)

IN this convenient form Prof. Bugnion has now given us an English translation of the important chapter originally contributed by him as an appendix to the third volume of Forel's "*Le Monde Sociale des Fourmis.*" No new matter appears to have been added. The part played in termite life by the necessity of presenting a constant defensive against the attack of ants is vividly noted and suggestions are offered as to the probable influence this warfare has exercised on termite evolution. The illustrations are numerous and excellent.

Man rises to Parnassus. By HENRY FAIRFIELD OSBORN. Pp. xix + 217, with 84 text-figs. 1928. (Princeton : Princeton University Press. London : Humphrey Milford. 11s. 6d.).

PROF. OSBORN is well known to archæologists and other students of the past history of mankind by his volume "*Men of the Old Stone Age.*" The present work is a logical sequel to the earlier one, in that the author is here concerned with the mind rather than the body, and that, even when he is constrained to deal with material things, he views them from the mental and spiritual standpoint. As he himself says, his object is "to show how the mind and spirit of man developed through the conquest of one great obstacle after another, in which intelligence rather than brute force always played the guiding part."

After an introductory chapter, the reader is plunged into the problem of the probable existence of Man in the late Pliocene. After a general, but none the less careful, account of the rostro-carinate sub-Crag implements of East Anglia follows a résumé of the information concerning the Foxhall jaw. In the same chapter there is a discussion of the Piltdown controversy, and here Prof. Osborn makes it very clear that he now accepts the jaw as being one with the skull, and not as formerly part of a chimpanzee. Short references to the giant flints of Cromer (with the interesting, but not very practicable suggestion that "the supposed sub-Forest Bed floor should be guarded by the English as a national monument"), to *Pithecanthropus*, and to Trinil close the chapter.

To the remote ancestors of the past, known to us only through very sparse skeletal remains, and the most primitive stone implements, there succeeded the cave-dwellers. Prof. Osborn is concerned to show their prowess in art, both graphic and plastic. To this end he gives the stories of such famous caverns as the Tuc d'Audoubert and the Caverne des Trois Frères.

Sections on the Scandinavian civilizations of Campignian times and later, and on the Neolithic and Bronze Age sun-worshippers of Brittany conclude a very readable volume, which is a credit both to author and publisher.

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Vol. I

BACTRIAN CAMEL.

By J. G. DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

THERE exist at the present day two distinct species of camel : namely, the single-humped Arabian Camel (*Camelus dromedarius*), and the double-humped Bactrian Camel (*Camelus bactrianus*). The Arabian Camel is quite unknown in the wild state, but reports have been received from time to time of wild Bactrian Camels living in the deserts of central Asia; in a domesticated state the latter species occurs throughout the greater part of Turkestan and spreads westwards as far as the Crimea and eastwards to Lake Baikal and Pekin.

The coat of the Bactrian Camel is very long and shaggy in winter, the hair on the head, neck, and shoulders being of remarkable length, and the humps vary in size according to the season and the supply of food available. It is heavier and shorter in the leg than the Arabian Camel, and in its winter coat very much more hairy. The two species, however, breed together freely, and in Asia Minor the hybrids are preferred to either of the pure breeds.

The origin of the domesticated Bactrian Camel is very obscure, and at one time it was doubted if it really were a native of the localities where it now occurs in a state of domestication. The discovery of fossil remains in various parts of Europe and Asia would seem to indicate that north and central Asia and eastern Europe were the original home of this species. The habitat of the wild camel was given by the late Major C. S. Cumberland as the Gobi steppe from Khotan to Lob-Nor; it does not appear to range further east than the Edzina River, and to the west of Lob-Nor it becomes scarcer and scarcer as the valley of the Cherchen Daria is ascended. Whether or no any of these camels are truly wild it is impossible to decide. It may be that in some districts they are only feral, that is to say, they are the descendants of domesticated animals which have reverted to the wild state; in other localities it is possible that they are truly wild. There appears to be no doubt that the "wild" camels and the domesticated Bactrian Camels represent one and the same species.



BACTRIAN CAMEL.

The Bactrian Camel is able to withstand both very cold and very hot weather. During Colonel Przewalski's journey across the Mongolian plateau he experienced the most intense cold, and, although the thermometer sank to -37° C. daily, he crossed the plateau without losing a single camel; on the other hand, he found that a ground temperature of 62.5° C. in summer in the Gobi desert had no adverse effect upon the animals.

The camels, llama, and vicugna form a distinct section, the Tylopoda, of the sub-order Artiodactyla of the order Ungulata. The section contains but a single family, the *Camelidæ*, which includes the two genera *Camelus* and *Lama*. In these animals the two main toes only are developed in each foot, the toes (third and fourth) bearing nails instead of hoofs, and having a broad, fleshy pad for walking purposes. Unlike so many members of the Ungulata, the *Camelidæ* have neither horns nor antlers. The stomach is noteworthy on account of the presence of a number of large cells in which water can be stored. At the present time this family has a very discontinuous distribution, the camels belonging to the Old World, and the llamas being found only in South America; in the Tertiary period the group was well represented in both North America and eastern Europe. Llamas are distinguished from camels by their smaller size, absence of humps, and large ears. The Guanaco, or Wild Llama, differs from the vicugna in having bare callosities developed on the limbs; it is found between the Chilean Andes and Patagonia southwards to Tierra del Fuego. The vicugna came originally from Peru; the range of distribution includes Ecuador and central Bolivia.

The Bactrian Camel which is represented in the figure was recently presented by the Rowland Ward Trustees, and has been placed on exhibition in the Lower Mammal Gallery; it was mounted in the Rowland Ward Studios.

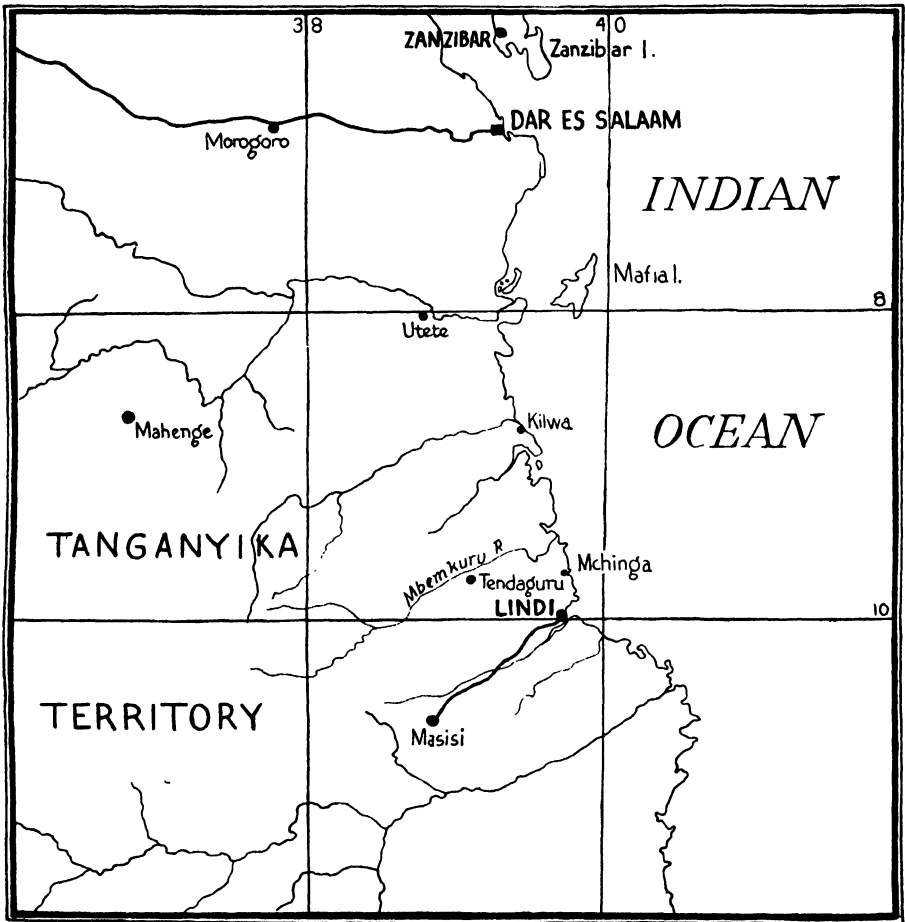
THE DINOSAURS OF TENDAGURU.

By JOHN PARKINSON, M.A., Sc.D.,

Leader of the British Museum East Africa Expedition.

IN Tendaguru and its neighbourhood lies but little to interest the casual passer-by. Although the dinosaur bones are sufficiently arresting when seen, they are little obtrusive as they lie in the ground. Approaching from the south, after a journey

of about sixty miles along roads lined by cocoa-nut and mango trees, or fields of millet and maize, and then along rougher forest tracks which are occasionally much used by elephants, the traveller sees far away a small conical hill, conspicuous by reason of the flatness of the surrounding ground and standing promi-



MAP OF TANGANYIKA TERRITORY,
Showing the position of Tendaguru, near Lindi,
where the Dinosaur deposits have been explored.

nently up against the sky; that is Tendaguru. The forest-covered plain about it, which shows a uniform surface of tree-tops, is in reality cut by numerous water-channels, usually dry, and is for most of the year covered by long grass. The area is sparsely inhabited, and only a few huts with attendant patches

of cultivation are dotted here and there; the village of Tendaguru is relatively of some importance. From the top of the hill a few hills, more sharply outlined than it and ridge-like, are visible in the distance in a westerly direction. These hills are built up, not of sands and clays as at Tendaguru, but of the hard crystalline rocks that form part of the general floor of Africa, which is a complicated group of vast antiquity, consisting of schists (containing garnets and graphite in quantity), gneisses, and intrusive masses of granite. On these as foundation, after almost interminable ages, the beds of Tendaguru and the coastal belt were laid down in lagoons or along the sea margins of that time. To the north and south of the hill the country is characterized by plateaus which rise to a height of about 1650 feet above sea-level and are formed of the red and terra-cotta sands known as the Makonde Series; their worn edges are visible from afar as conspicuous cliffs. It is between these in an old valley, now occupied by the Mbenkuru River and its tributaries, that the deposits containing reptilian bones are found.

Nature has removed the overlying sediments, and the red beds have gone. The rain and rivers have cut through the alternate layers of fine sands and clays in which the dinosaurs were trapped and lie entombed. The strata of Tendaguru are therefore the relic of a former time, namely, the consolidated rain-wash from the surface of the younger Africa that existed at the close of the Jurassic and the beginning of the Cretaceous periods, anterior to the deposition of the English chalk, when the sinking of the land and the consequent inroads of the sea led to the subsiding shores receiving the deposits of an older and larger Mbenkuru. The marine beds, which are intercalated with the beds containing reptilian remains, contain shells of considerable scientific value.

It was in 1907 that Dr. Frass, of Stuttgart, published the discovery of the dinosaurs of Tendaguru, and for some years (1909-12) a German expedition actively carried out excavations over the area, and reaped a rich and virgin harvest, as is shown by the gathering of 250 tons of bones which they obtained. The Trustees of the British Museum sent out in 1924 an expedition to continue this work (Fig. 1). The expedition naturally found itself confronted with the task of carrying on the excavations on ground where the obvious spots had nearly always been carefully worked over by its predecessors.

Problems presented themselves, which, though of less sensational interest than the discovery of a thigh-bone, nine feet long, were nevertheless of great scientific importance. The

marine life of the period is well represented. The numerous bivalves and univalves which locally strew the hillsides afford material for an important study, not merely because by means of their identification the age of the beds in which they lie may be determined, but because the resemblances that they show to others which have been found in South Africa, Western India, and South America may help towards the solution of the problem of the position of the principal land-masses at that time.



Photograph by

Major T. Deacon.

FIG. 1.—HUTS AND BONE-STORE AT TENDAGURU, WITH EXPEDITION'S QUARTERS
ON HILL TO LEFT.

The exact age of these dinosaurian remains is in some doubt, but the further collecting of specimens, combined with the careful mapping of sections across the ground, will clear up this point and bring the era when these gigantic reptiles, floundering on the borders of the Mesozoic sea, were engulfed by torrents or borne eastwards to sink and be entombed in lagoons or sandbanks, more closely into line with the age of other great populations of dinosaurs in America, Eastern Asia, and even our southern English coasts.

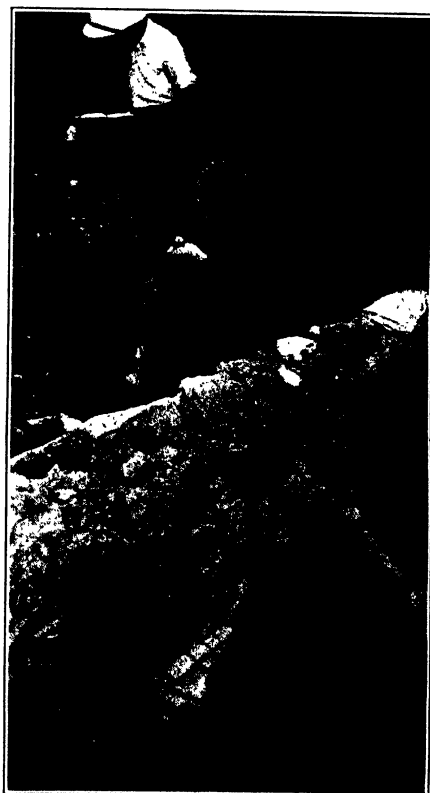
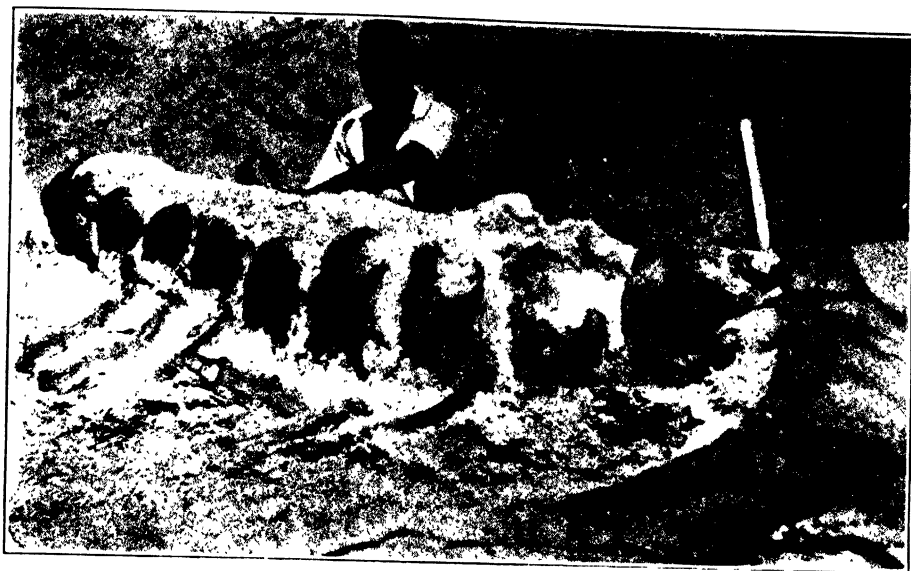
How did the dinosaurs of East Africa meet their death? On this question there is no important diversity of opinion. Dr. Schuchert remarks that, in spite of the relatively extensive excavations and explorations carried out by the Germans, no

single complete skeleton was found and skulls were rare. For preservation of the skeletons rapid entombment is necessary; it is surprising how few skeletons are found to-day, even in those parts of Africa most densely populated by herds of game. Great numbers of zebra, hartebeeste, and gazelle live and die; their bones are picked clean by vultures, are dismembered and scattered by hyænas, and disappear, seldom leaving any trace of their former existence on the plains where once they roamed. Dr. Schuchert has summarized the various conclusions that have been put forward as to the death of the mighty if unintelligent reptiles of Tendaguru. Prof. Janensch, who took a leading part in the German expedition, considers that the habit of walking on the mud-flats left bare behind the ebb-tide resulted now and again in the animals being bogged in the yielding ooze, where they remained stuck, either to be drowned by the rising tide or to die slowly and eventually become entirely engulfed. In support of his theory he puts forward the occurrence of complete feet and elsewhere of an upper arm bone over six feet long, part of the associated lower arm, and part of a shin, which were standing together vertically in the mud, the dismembered skeleton lying close by. Such discoveries are very rare, but the character of the sediments around the bones affords some help in understanding the conditions existing on the coast in the time of the dinosaurs.

In general, the beds known as the Tendaguru Series are predominantly sandy and, unlike their South African representatives, which are twisted by earth movements from the original gently sloping angle of deposition, lie almost horizontally. Pits which are dug close to one another show a discontinuity in the beds of sand and indicate banks formed in shallow water; the kind of herring-bone effect in the sand layers known as cross- or false-bedding was caused by the rapid changes in direction whence the sediment came, resulting from the shifting flow of the currents. Such is the character of the silts near the bones, and often it is on so small a scale that we can scarcely avoid believing it to betoken the existence of swirls and eddies, miniature whirlpools in which bodies were sucked down. Schuchert, on the other hand, pins his faith to "drowning in the valleys in times of freshets, and hence the transport and assorting in the direction of the stream currents," as the cause of the deaths of the dinosaurs; on the whole, I am inclined to agree with him. Nevertheless, the sea must at times actually have covered the bodies of the dead reptiles, for belemnites—marine mollusca resembling cuttle-fish—have been found clearly contemporaneous with the

reptiles, since they have been buried together. Near Mtapaiia, not far from Tendaguru, the German geologists record an instance where sea-shells which were amongst the bones of a solitary dinosaur lay above and below beds containing the remains of abundant molluscs indicative of shallow seas. To the quick action of freshets Schuchert attributes the entombments of dozens of a small reptile—an ornithopod akin to the American *Nanosaurus* and another species named *Kentrurosaurus*—at Kindope, lying a short hour's walk from Tendaguru Hill. The bone-bed—for such it appears to have been at the time of its discovery, so numerous were the remains—was excavated by the German geologists, and some 15,000 separated small bones were found. The skeletons of fifty *Kentrurosauri* were obtained from a space not more than thirty metres square, the largest being about five metres in length. This site was reopened by the British Museum Expedition last year. This tragedy of *Nanosaurus* and his confrères Schuchert considers as due to drowning in river valleys by floods, the bodies being subsequently piled together in a sheltered spot; Janensch, on the other hand, considers the reptiles to have died in the place where they were found as the result of some catastrophe.

It will be gathered that, to some extent, the discovery of skeletons is largely a matter of luck, and the worker is apt to be misled by the occurrence of broken bones lying uncovered on the surface of the ground, generally a quantity together, but not conspicuously water-worn. These I believe to have been transported to their present resting-places at a comparatively recent time. There is direct evidence that this may be so, for pebbles and small boulders commonly cap the hill-tops and slopes, and are thus clearly the relics of former rivers, larger than any now existing in the neighbourhood and due to a heavier rainfall. Excavations in the neighbourhood of surface bones have shown so far only fragments scattered at rare intervals through the six or eight feet of sands so exposed. Once the bones have been found, their removal from the rock wherein they lie presents few difficulties to an experienced workman. Very friable and rotten examples are rejected; frequently they are in an almost crumbly condition and, unless exceptionally rare, are then useless. There is a large proportion of limb bones; at “St,” one of the principal Kindope sites, femora were almost twice as numerous as humeri and scapulæ were intermediate in number, but the actual proportions no doubt vary according to conditions. Vertebræ, though rarely perfect, are very common, but the greatly desired skull is exceedingly scarce.



Photographs by

Major T. Deacon.

FIG. 2.—PELVIS AND ADJACENT VERTEBRAE OF A DINOSAUR
FOUND NEAR TENDAGURU HILL.

A few teeth are found here and there; at Kindope we discovered two very ill-preserved and fragmentary remains of jaws, and the Germans in their much more extensive operations unearthed three large skulls, six smaller and eight fragments of the hinder parts of others. The smallness of many sauropod skulls and their relatively somewhat delicate construction probably account



Photograph by

Major T. Deacon.

FIG. 3.—NGURUWE, NEAR TENDAGURU HILL.

Pit (in the centre), bones plastered ready for transport.

for their not being recognized if excavated or even not being noticed at all.

The bones, when found, are carefully uncovered, the later stages of extraction being carried out by means of awls, fingers, and a soft brush, and as much of the sides being exposed as is consistent with the safety of the specimen (Fig. 2). If the bones are friable, strips of cloth are dipped in plaster of Paris mixed to the consistency of cream, and are applied criss-cross to the surface of the specimen over sheets of thin paper which,

when soaked in water, adhere to the specimen and prevent the plaster sticking to it when unwrapped. After the strips of cloth, of the strength of thin calico, have been satisfactorily arranged, handfuls of plaster are dabbed round the specimen and left to dry (Fig. 3). The upper half is now complete and it only remains to clean the matrix away from the part still hidden and turn the specimen over. The process of paper, strips of cloth, and plaster is repeated for the under side, and the bone is finally, when labelled, ready for transport. Since weight is an important factor when men are employed to carry loads for considerable distances, the specimens are not placed in crates until the coast is reached. For the sake of lightness, therefore, trays of sticks, bound together at either end, are used for transporting the bones, and are wrapped round with bundles of grass. According to the weight they are arranged for portage by one man or by two men or more (Fig. 4). The loads have thus to be carried to Lindi, the nearest port for shipment, about sixty miles away. No attempt is made to name the specimens on the spot; that would be prevented by lack of books and of time, even were the difficulties of classification not too great for any but a specialist owing to the astonishing variation in size and appearance of the animals.

The age of the dinosaurs at Tendaguru heralded in the dawn for the hosts of mammals that were to follow, but it was high noon in the day of reptiles, and at the close of the Cretaceous era they disappeared altogether. While these creatures flourished, Nature appeared to excel herself in colossal size and fantastic shape. The *Gigantosaurus africanus* from Tendaguru was as large as the *Diplodocus Carnegii* from North America, and *Branchiosaurus Brancai*, also from Tendaguru, was even bigger and was probably the largest of all land animals; a forearm has been found measuring as much as seven feet in length.

The latest classification, by S. W. Williston, divides the dinosaurs into two orders characterized by the form of the hip-girdle or pelvis, the ischium being chosen for the necessary distinctions. If it resembles that of the majority of reptiles, the group is named Saurischia, and if that of birds, it is called Ornithischia. The former is again divided into two sub-orders characterized by the structure of the feet: Theropoda, more or less bipedal, the hind feet tending to be digitigrade and the pubes uniting in a long ventral symphysis (carnivorous and containing the earliest known genera); and Sauropoda, containing those mighty brutes from rocks of Lower Cretaceous age, approximately corresponding to the sandy sediments of Tenda-

guru—*Gigantosaurus*, *Atlantosaurus* (from Colorado), and *Diplodocus*. Amongst the Ornithischia we find a relative of *Nanosaurus*, from Colorado, the size of a cat, and the armoured



Photograph by

Major T. Deacon.

FIG. 4.—PORTERS STARTING FROM TENDAGURU WITH
LOADS OF DINOSAUR BONES.

Stegosauria which lived from the Jurassic to the end of the Cretaceous. Stegosaurs are numerous at Tendaguru. *Stegosaurus* itself, from the Upper Jurassic of Colorado, was extraordinary even for a dinosaur; although about 17 feet long it

was handicapped by a brain smaller, relative to its great size, than any other land vertebrate, and, indeed, the capacity of the nerve cavity of the hip region exceeded that of the head ten times. It was, however, compensated—if compensation it were—by two rows of enormous scutes, rising like huge saw teeth along the back from skull to tail.

Another classification, adopted by Eastman and Hatcher, is based to some extent, like the last, on the disposition of the bones of the feet. Such subdivisions involve technicalities, although not serious ones, and Dr. W. D. Matthews in 1920 devised a more descriptive arrangement of the Canadian dinosaurs. Hence we have the "Duck-billed Dinosaurs" with a heavy and flattened beak, of which *Trachodon* is an example, and the "Horned Dinosaurs," such as *Triceratops* and his allies, provided with a huge head armed with horns and protuberances and a "frill" or extension of the skull over the back of the neck. The "Armoured Dinosaurs," on the other hand, possessed small triangular heads but enormous bodies covered with bony plates. These were vegetable feeders and quadrupedal. The flesh-eaters, such as *Megalosaurus* and *Tyrannosaurus* from the United States, formidable animals measuring 48 feet in length and 18 feet in height, with jaws 48 inches in length, and answering in general to the Theropoda of Marsh, were, as mentioned before, bipedal, running on their hind legs with their short forefeet held high above the ground; their large, sharp, serrated teeth and long, curved claws were doubtless well fitted to their requirements.

Matthews' last section contains a rare reptile, distinguished by a long neck and very small head with a beak resembling an ostrich's, from which, together with the appearance of the feet, the animal has been named *Struthiomimus*, or "Ostrich dinosaur." Unlike the earliest birds, this reptile had no teeth, the front legs were insignificant, but, as Matthews remarks, were "curiously suggestive of those of a tree sloth in their proportions." It was doubtless adapted to some special mode of life as yet unknown. Only one locality is given by the German geologists for the occurrence of the winged reptiles grouped together as the Pterosauria; excellent specimens are found in the Natural History Museum.

The species discovered up to the present time in Tanganyika Territory are not very numerous in view of the diverse and widespread array of dinosaurs that existed during the Mesozoic period which preceded the oncoming of those later times leading up to Man, but no doubt more remain to be discovered round

Tendaguru alone. This rough outline of the classification given may serve to reveal the prodigal variety of form, size, and habit of the reptiles that inhabited the world in those distant days.

“FISH FROM THE CLOUDS.”

By J. R. NORMAN, Assistant, Department of Zoology.

“Dozens of tiny red fish were found on the roof of a bungalow on the farm of Mr. James M'Master, Drumhirk, near Comber, and on the ground in the vicinity yesterday morning, and the extraordinary occurrence caused considerable speculation. In the course of inquiries it was ascertained that just before the discovery of the fish there had been an exceptionally violent thunderstorm with heavy rain. There is no river in the neighbourhood, the nearest sheet of water being Strangford Lough, two miles distant, and the theory advanced by an expert was that the fish had been lifted from the sea in a waterspout.”—*Northern Whig and Belfast Post*, May 30, 1928.

THIS cutting, which appeared extensively in the English daily press, has aroused considerable interest, and several inquiries have been received by the Museum as to the credibility of the occurrence.

As far as can be ascertained, the published accounts of these “rains of fishes” number about forty-five. These have been reviewed in detail by Mr. E. W. Gudger of the American Museum of Natural History in a paper published in 1921 (*Natural History*, vol. xxi, pp. 607–19), from which the following particulars have been largely extracted. This work contains a complete list of the literature on the subject.

The first and oldest mention of this phenomenon occurs in the “*Deipnosophistæ*” of Athanæus, who lived at the end of the second and the beginning of the third century A.D., a work which contains quotations from several hundred authors whose writings have not come down to us. In an English translation, under the heading “*De pluvia piscium*,” we read the following:—

“I know also that it has rained fishes. At all events Phœnias, in the second book of his *Eresian Magistrates*, says that in the Chersonesos it once rained fishes uninterruptedly for three days, and Phylarchus, in his fourth book, says the people had often seen it raining fish.”

As far as we know, no further account occurs until 1698, when one Robert Conny published a letter in the *Philosophical Transactions of the Royal Society of London*, in which he described

the appearance of numerous small fish in a pasture field at Cranstead near Wrotham, Kent.

Space will not permit me to deal with the remaining accounts in detail, but it will suffice to point out that they appeared in books and journals differing widely in character—works on meteorology, travel, history, and natural history. Some of these were mere hearsay, others seem to have been fairly well attested, and others are furnished by reputable men of science, who either observed the actual fall of the fishes or found them immediately after a heavy storm lying on ground which would ordinarily be quite dry. Analyzing these accounts geographically, we find that seven falls are recorded from the United States, one from Canada, one from England, nine from Scotland, eight from Germany, one from France, one from Greece, ten from India, two from Ceylon, two from the Malay Peninsula and Archipelago, and one from the Society Islands in the South Seas; until the present record, no account of this phenomenon occurring in Ireland had been published.

In some cases the “rains of fishes” have occurred in the neighbourhood of towns, and we read in Rees’s (*Cyclopædia* (1819, vol. xxx, under the heading “Rains—preternatural”) that the “streets of a town near Paris were found to be covered with fish of various sizes up to five or six inches long.” In the East Indies (Anonymous, *Annals of Philosophy*, 1816) small fishes, said to have come down with the rain, have been found in tanks placed on the roofs of houses to catch the rain-water. Mr. James Prinsep (*Journ. Asiatic Society of Bengal*, 1833, vol. ii) records the fall of a small fish into the brass funnel of his rain-gauge at Benares, which stood on an isolated stone pillar, raised five feet above the ground in his garden. It is of especial interest to note that in a “rain” recorded from Calcutta in 1839 (Tomlinson, 1864) the fish are said to have fallen only “in a straight line, not more than a cubit in breadth.” The same author mentions another fall which occurred at a later date near Aberdare in Scotland, and states that the fish “covered the ground in a long strip of about eighty yards by twelve yards”: some of these fish, which were still alive, were exhibited in the old Aquarium House of the Zoological Gardens in London. The most extraordinary happening occurred in Essen in 1896, and was related by Hermann Landois. During a heavy storm a hailstone about as large as a hen’s egg was observed to fall, which contained a frozen Crucian Carp about 40 mm. in length.

In most of the recorded “rains” the fish appear to have been quite small, but we read of a fish falling with others at Jelalpur

in India which was about one cubit in length and weighed more than six pounds. Various species of fish have been involved, European falls including herrings, sprats, trout, smelts, pike, minnows, perch, and sticklebacks. The tiny red fishes mentioned in the present Irish account may have been sticklebacks.

There seem to have been several alternative theories put forward to account for these phenomena, and it is probable that different explanations may apply to different cases. The principal alternative theories may be briefly outlined.

1. The fish may have been migrating overland from one pond or stream to another. This may conceivably explain some of the "falls" which took place in tropical countries, but in northern regions the only fish likely to migrate for any distance overland is the eel, a species which has never been mentioned in connexion with "rains of fishes." Furthermore, in some cases the fishes picked up were *marine* species: in Scotland, for example, showers of young herrings and sprats have been recorded from places situated at some considerable distance from the sea.

2. The suggestion that the fish may have been left behind by overflows may be dismissed as improbable.

3. They may have been dropped by piscivorous birds. This again is unlikely, as the fish have nearly always been described as fresh and entire, and showing no trace of mutilation. Further, the specimens are generally too numerous to be explained in this way.

4. They may have been aestivating, and have been brought to life by the rain. This might explain certain "falls" which have taken place in tropical countries, where there is a prolonged dry season and where some species of fish possess this habit.

5. Finally, we are left with the suggestion, first put forward by Eglini in 1771, that the falls are due to the action of heavy winds, whirlwinds, and waterspouts, and in view of the fact that nearly all the recorded "rains of fishes" have been described as being accompanied by violent thunderstorms and heavy rain this explanation seems to be the most feasible. Further, the fact that the falls are nearly always confined to restricted areas, and that the fishes are often found in a comparatively straight path over a wide stretch of country, seems to provide additional evidence in support of this view.

There is no doubt as to the ability of waterspouts or tornadoes to lift small fish to a considerable height and to transport and deposit them at some distance from the place at which they were picked up. There are many cases on record of tornadoes lifting objects of considerable size, such as pieces of timber, roofs of

houses, and even human beings, and carrying them for long distances. Waterspouts and tornadoes are physically similar phenomena, the former occurring over stretches of water or over the ocean, the latter over the land. Tornadoes sometimes pass from land to water and become waterspouts, and vice versa. In general, however, the phenomena reach greater intensity over land, so that tornadoes are usually more severe than waterspouts. Both originate in the region of strong convergence of horizontal currents of air in the forefront of travelling thunderstorms and line-squalls. The latter are themselves lines along which a relatively cool current of air is converging on and cutting into a relatively warmer one and are often the seat of thunderstorm phenomena.

A waterspout or a tornado consists of a long, slender, rapidly rotating vortex of air, extending upwards from the earth's surface into the base of a cloud of the cumulo-nimbus or thunderstorm type, normally some 2000 or 3000 feet above, as illustrated in the accompanying photograph of a waterspout observed off the Italian coast. From the present point of view the essential features are the strong inflow of air along the earth's surface at the base of the whirl, and the upward spiral motion round the central axis of the spout, though there is evidence that there is in general no ascent, but even a descent, along the axis itself in a fully developed system. The magnitude of the ascending component in the air motion varies from one spout to another and also during the various phases in the life-history of an individual spout, but it must attain a considerable magnitude at some stage. It should, however, be remarked here that the column is not necessarily rendered visible by water or other material lifted from the surface, but chiefly through the reduction of atmospheric pressure in the column, necessary to balance the spin, causing cooling of the air. If the spin becomes sufficiently great, the temperature is lowered to the dew point and water condenses out in the form of cloud, so producing the visible effect which occurs in tornadoes over land as well as in waterspouts over the sea.

Surrounding the base of the spout is another vortex of annular character, which, in the case of a waterspout, raises the spray from the sea to a height usually considerably less than that of the cloud base, carrying the spray upwards and outwards on all sides in fountain form. This effect is also illustrated by the accompanying photograph.

Small fish might possibly be lifted and transported by this latter vortex. There is, however, strong evidence that this is

not always the case, even if it is so at all, but that the fish are carried in the main vortex right up into the thunderstorm cloud. We have, for example, the fact that they are usually found after the rain, which does not fall in the immediate vicinity of the tornado or waterspout, but in another part of the thunderstorm system. There is also the particular instance, already quoted, of the small Crucian Carp embedded in a large hailstone, and which must, therefore, not only have entered the thunderstorm



A REMARKABLE PHOTOGRAPH OF A WATERSPOUT OVER THE SEA
OFF THE ITALIAN COAST.

(From Carpenter and Wilson Barker's "Nature Notes for Ocean Voyagers.")

cloud but have been carried up in it to the very considerable heights necessary for the formation of hail.

Tornadoes have been stressed as much as waterspouts in this article, because fish would naturally be more easily picked up from shallow water than from the open ocean. In the majority of the cases the sources of the fish are probably either shallow inland pools or shallow coastal waters.

The detailed structure of waterspouts and tornadoes is very complicated, but the features to which attention has been

directed will no doubt serve to illustrate the tenability of the theory that showers of fish are usually to be attributed to phenomena of this character associated with thunderstorm or line-squall conditions.

In conclusion, it may be pointed out that fishes are not the only animals which have been recorded as falling from the sky, for "showers of frogs" are by no means uncommon occurrences. These may also be due to the action of tornadoes or kindred meteorological phenomena, but sometimes there is a simpler explanation of their sudden appearance in large numbers on land. Many thousands of tadpoles may undergo their metamorphosis simultaneously, and if the weather is at all dry they will hide away under rocks and stones or in any cool place; after the first rain, however, they will promptly come out into the open, and so sudden is their appearance that it is not surprising that they are regarded as having "come down from the clouds."

The author is much indebted to Mr. M. A. Giblett, of the Meteorological Office, for kindly supplying him with the meteorological notes incorporated in this article.

* * * * *

Since writing the above, my attention has been directed to an account of a shower of Sand-eels (*Ammodytes tobianus*) which occurred near Sunderland in August 1918, and was recorded by Professor A. Meek (*Nature*, 1918, vol. cii, p. 46). For the space of about ten minutes hundreds of these fishes, nearly all about three inches in length, were precipitated over an area measuring approximately 60 yards by 30 yards (*i.e.* about one-third of an acre.) This "fall" took place at a distance of about a quarter of a mile from the sea-shore during heavy rain accompanied by thunder, and the fish were stiff and hard when picked up immediately afterwards.

FLUORESCENCE OF MINERALS IN ULTRA-VIOLET RAYS.

By L. J. SPENCER, M.A., Sc.D., F.R.S., Keeper of Mineralogy.

CERTAIN crystals of fluorspar (fluor or fluorite), especially the twinned cubes from the lead mines of Weardale in County Durham, display different colours when viewed from different

points of view. The colour as seen varies according to the relative positions of the source of light, the specimen, and the eye of the observer. When the crystal is between the source of light and the eye one colour is seen, and when the eye is between the crystal and the source of light another colour appears. The difference depends on whether the crystal is viewed by transmitted or by reflected (scattered) light. If a clear transparent crystal be held up to the window, the colour seen may be pale shades of brown, pink, green (in some crystals a good emerald-green), or colourless, these colours being usually arranged in alternating layers parallel to the cube faces of the crystal; but when the same crystal is viewed by reflected light, with the back of the observer towards the window, a totally different colour is seen. This appears, especially in direct sunlight, as a rich bluish-violet glow or shimmer diffused over the surface of the crystal, very much like the bloom on a ripe plum. When a lens is held in front of the crystal, a conical beam of sunlight inside the crystal is traced out by this colour.

White light, such as sunlight, may be resolved into its component colours by various methods. Everybody knows the colours of the rainbow and the "prismatic colours" produced when light passes through a prism (such as the bevelled edge of a mirror)—red, orange, yellow, green, blue, indigo, violet. These colours are the expression of the differences in wave-length, which are successively shorter from red to violet. The spectrum of sunlight is, however, not confined to the rays visible to the eye. Beyond the red we have the infra-red, these being heat-rays of longer wave-length; and beyond the violet the ultra-violet—chemically active rays of shorter wave-length.

If we place a small crystal of fluorspar in the red part of the spectrum of sunlight nothing remarkable happens, but when it is moved up to the violet end it begins to glow with a bluish-violet colour; and this glow becomes more intense when the crystal is moved farther on into the invisible ultra-violet. The crystal possesses the curious property of absorbing the invisible rays of shorter wave-length and giving out in their stead visible rays of longer wave-length. It is, in fact, acting as a transformer of the wave-length. Just how this happens we do not know. A learned discussion with mathematical treatment of the relation between the ether vibrations of light and the orbits of electrons would be out of place in this Magazine.

This interesting phenomenon, shown *par excellence* by fluorspar, was termed fluorescence (from analogy to opalescence)

by Sir George Gabriel Stokes * in 1852. It had been first investigated by Sir David Brewster in 1834 to 1848, and by Sir John Herschel in 1845, and was also studied by Dr. John Hall Gladstone † in 1855. But it still remains a puzzle, although voluminous treatises have been written on the subject by German physicists.

An important point to bear in mind is that a fluorescing body is self-luminous, and, like a glow-worm, it is a source of light. This "cold light" is the most efficient form of lighting, for there is no accompanying waste of energy in the production of unwanted heat. It is the lighting of the future.‡ Now-a-days, for example, we strike a match for two totally different purposes—to shine a light or to light a fire. In one case we want light and in the other heat, so we use one and waste the other. Further, the fluorescent colour emanates from the body itself; it is not a selective colour depending on the nature of the outside illumination. (A rose that is red in white light will be black in green light.)

Fluorescence is shown directly in ordinary light by comparatively few substances. Besides fluorspar, we have the mineral-oils (petroleum), including their separation products, paraffin-oil (kerosene) and the heavy lubricating and engine oils, which, as is well known, display blue and green colours on the surface by reflected light. It is also well shown by certain aniline dyes, such as fluorescein and eosin, and by uranium-glass. Usually, however, for most substances the fluorescence is masked by the daylight. The phenomenon is shown to the best advantage in a dark room and using only the dark ultra-violet rays to excite the new radiations. High-tension electric sparks are rich

* In 1892 at Cambridge I was fortunately able to attend a short course of lectures on fluorescence given by Sir George Stokes. His experiments, with the simplest and most primitive of apparatus, were performed in a beam of sunlight admitted through a slit in a shuttered window. For each experiment it was necessary to wind down the heavy shutter and each time solemnly to wind it up again. He continued to talk in his feeble voice while grinding away at the winch-handle of the creaking rack and pinion, with the result that very little was heard of his lectures. When I offered to help the feeble old man in this laborious operation I was severely told, "Young man, keep your place."

† Some of Dr. Gladstone's original materials were sent to me by his daughter, Miss Florence M. Gladstone, only a fortnight before her death in July 1928.

‡ Fluorescence may be excited by several different methods. The radioactive method by mixing a radium salt with a luminous paint is much used for watch dials. The method with a mercury-vapour lamp, although very convenient for experimental purposes and for a small display, would be very wasteful economically for lighting on a large scale.

in ultra-violet rays. Sir George Stokes made use of lightning in some of his experiments on fluorescence, but he found that this was not easy to control. Striking results may be obtained with a Ruhmkorff coil or a small transformer stepping up to 4000 volts and sparking between iron terminals. But the most convenient and efficient source of ultra-violet rays is the silica-glass mercury-vapour lamp, which is now much used for the production of "artificial sunlight." A screen of a special kind of dark glass cuts out all the visible rays of light and allows only the ultra-violet rays to pass out of the apparatus.

While on a visit in 1924 to the famous mineral locality of Franklin Furnace in New Jersey, I was much interested in a simple method used by the New Jersey Zinc Company for the quick detection of willemite (zinc silicate), which is an abundant mineral in the zinc ores at that locality. In several of the laboratories and offices there was fixed to the wall in a dark corner a small apparatus giving a high-tension spark which could be switched on from the lighting circuit. A piece of ore held beneath the spark showed up any willemite present by a vivid green fluorescence. Some very pretty effects were obtained; for example, specks of pale green willemite embedded in snow-white calcite glowed as brilliant green spots in a crimson background. This simple test I thought might be applied to the zinc ores of Broken Hill in Northern Rhodesia. In these mines there are large quantities (over 100,000 tons) of a peculiar "yellow rock" or "yellow waste" carrying up to 33 per cent. of zinc oxide, which had never been completely determined mineralogically, although in 1908 I had detected in it some obscure crystals of willemite. These minute crystals when exposed to the ultra-violet rays showed a bright yellow fluorescence, quite different from the brilliant green of the Franklin Furnace willemite. Trying willemites from other localities, I found that, while some showed a bright yellow or a dull dark-green fluorescence, most of them showed none at all. Even certain types of willemite from Franklin Furnace were found to be unresponsive.

I was therefore forced to the conclusion that fluorescence in ultra-violet rays is not a sure test for willemite, and I very soon found that the same applies to other minerals. Some specimens of fluorspar show no fluorescence, and this is the case with the single specimen of the Derbyshire "blue John" that I have tried, although I have been told that this variety of fluorspar shows it to perfection. Thinking that the fluorescence might be due to traces of colouring matter present in the mineral, some

small perfectly colourless and water-clear crystals of fluorspar from the iron mines of west Cumberland were tried : these displayed a very rich and deep violet fluorescence. On the other hand, some dark-coloured specimens from other localities showed no fluorescence.

A set of twenty-three small crystals of diamond from British Guiana, selected to show the range in colour and the inclusions in the crystals, was tested in ultra-violet rays. A yellow-green octahedron gave a brilliant fluorescence of the same colour, three colourless crystals showed up a good blue, and the rest were unresponsive. Different varieties and specimens of the mineral species corundum also gave varying results. Red gem-corundum (ruby) shows a wonderful scarlet glow, and the stone appears to be surrounded by a halo. Exactly the same effect is shown by the artificially made rubies, and also by red spinel of gem quality. Yellow gem corundum gives an orange-yellow fluorescence, but the blue sapphire and the amethystine, green, and colourless gem varieties of corundum are unresponsive. Opals also are capricious. Only the purest of all opals, the colourless and water-clear "hyalite," was found to respond. Specimens from Mexico and from the Kaiserstuhl in Baden gave out a soft sap-green light ; but similar specimens from other localities refused to act.

These few examples serve to indicate that extremely variable results are obtained, and it is therefore not surprising that there are many contradictory statements in the literature. Many writers have remarked on the fact that they were unable to obtain the results recorded by previous observers ; and, indeed, in some cases the same experimenter has not always been able to repeat his own results, probably because he was not using the same materials and under exactly the same conditions. The early workers * were placed at a disadvantage in having only the inconstant sunlight at their disposal. Depending on the time of day or of year, sunlight has to traverse different thicknesses of the atmosphere, and consequently the absorption of the ultra-violet varies and in foggy weather is practically complete. (For this reason a patient for ultra-violet treatment is sent to the mountains rather than to the seaside.) The fluorescence of any particular substance is evidently excited by ultra-rays of a

* My own tests have been made under what I believe to be more constant conditions, using a Hanovia silica-glass mercury-vapour lamp at 1 ampère and 220 volts, with a dark glass screen passing ultra-violet rays of wave-lengths 390 to 310 $\mu\mu$ about. These longer ultra-violet rays can pass through several layers of glass, but I have made no quantitative measurements.

certain wave-length or over a certain range of wave-lengths; and unless just the right kind of rays are present no fluorescence is produced. Several writers have given glowing accounts of the behaviour of the mineral pectolite in the ultra-violet rays. I myself have tried various forms of pectolite from different localities, but always with negative results. Again, I read in a book that *æsculin* gives a brilliant fluorescence; but the sample that I obtained refused to act (perhaps because it was labelled "esculine"—indicating that it was an old preparation). However, with a new preparation of *æsculin*, obtained simply by pouring boiling water on horse-chestnut twigs, the tea-coloured extract showed a beautiful turquoise-blue fluorescence in the ultra-violet rays.

The selection of suitable materials, or rather of individual specimens, is thus quite haphazard. The majority of my trials have been complete failures. A possible method would be to go round the Mineral Gallery on a dark night with a portable ultra-violet apparatus, and so pick out those specimens which are possessed of the whim to glow up. But quite likely by the morning they would have changed their minds and then refuse to function. Time could scarcely be a factor, but they may be influenced by light, differences of temperature, humidity of the atmosphere, or even by the countless "wireless" waves of all manner of wave-lengths that now permeate everywhere. It would indeed be interesting to find a mineral, or crystal, that fluoresces to, say, "2LO."

Almost without exception fluorescent substances are transparent or at least translucent to light. It appears to be necessary that the rays should penetrate the substance to a certain distance for the effect to be produced. The most remarkable result that I have obtained is with a black opaque specimen of zinc-blende from Tsumeb in south-west Africa. It is a piece of massive granular zinc ore looking much like a lump of coal. This was tried because it shows in a very striking manner the allied phenomenon of triboluminescence (luminescence by rubbing): when it is lightly scratched with a knife-blade it gives streaks of yellow sparks. In the ultra-violet rays it glows with a brilliant fiery yellow like a live coal. When the specimen is lightly touched with the finger the merest invisible trace of the substance is picked up, but sufficient to give a good glow. Zinc-blende is quite a common mineral, but only certain specimens from Tsumeb and a pale-coloured variety from Beaver County, Utah, have been found to show the fluorescent glow.

Some substances fluoresce only in the solid state, others only

in the liquid state or in solution, whereas the metal sodium fluoresces in the gaseous state. Other substances show up only when their solution is painted on white paper or when used as dyes on fabrics. Often also, the presence of some other substance is necessary. Artificially prepared willemite (zinc silicate) shows no fluorescence when chemically pure; but the property is strongly brought out by the addition of a small amount of manganese. (This explains the fluorescence of the Franklin Furnace willemite; but why crystals of willemite found embedded in black manganese ore at the Sable Antelope mine in Northern Rhodesia fail to fluoresce, I cannot understand.) The various salts of quinine display their remarkable fluorescence to advantage only in the presence of free acid, the merest trace being sufficient. Many other vegetable alkaloids give strange results, and under the right conditions it is possible to detect the presence of some of these in one part in a thousand million. The behaviour of the wide range of plant products in ultra-violet rays would no doubt offer an even more fascinating study than mere minerals. It was in the alcoholic extract from laurel leaves that Sir David Brewster first discovered, in 1834, the phenomenon of fluorescence. A freshly prepared clear leaf-green solution of chlorophyll is remarkable in showing a deep blood-red fluorescence in the ultra-violet rays (and, curiously, the same red colour is seen by transmitted light through thicker layers of the solution, but this is a quite distinct phenomenon known as dichromatism).

An exhibition case to illustrate the fluorescence of minerals (and some other substances) in ultra-violet rays has been fitted up in one of the wall-cases in the corridor at the entrance to the Mineral Gallery. This is probably the first public exhibit of the kind, and during the August Bank Holiday week it attracted thousands of visitors. Marvellous changes in colour effects are produced by simply pressing a button outside the case. The specimens are first seen in ordinary light with inside electric lighting ("linolight"). When the button of the two-way switch is pressed, this changes over to ultra-violet rays, which are produced by a Hanovia "artificial sunlight" mercury-vapour lamp fitted with a dark screen to cut out all the visible light rays, allowing only the dark ultra-violet to fall on the specimens. Large groups of fluorspar crystals shine up with a wonderful bluish-violet glow, willemite and autunite with a brilliant green, zinc-blende with a golden yellow, white calcite with a rose-red, etc. When the spring-switch is released this fairyland of glowing colours suddenly vanishes.

The case has been painted with a dark grey background, care being taken to avoid a fluorescent paint. Labels for each specimen have been painted with a white fluorescent paint (zinc white) on dark grey card, and these are easily read in the two illuminations. Even in the lighted corridor the effect is very striking; but of course still better results would be obtained in a dark room, though this would be less suitable for public exhibition. The following is a copy of the label accompanying the exhibits :—

FLUORESCENCE OF MINERALS IN ULTRA-VIOLET RAYS.

The hanging apparatus contains a silica-glass mercury-vapour lamp which is tilted and put into operation by means of an electro-magnet when the two-way spring-switch is pushed. All the visible light rays are cut out by a screen of dark glass, and only ultra-violet rays are allowed to fall on the specimens beneath. Ultra-violet rays (or "dark light") are of the same nature as light rays, but they are of shorter wave-lengths. Certain minerals and various other substances when placed in the path of these rays possess the curious property of absorbing the invisible rays and giving out in their stead visible rays of longer wave-length. The resulting colours depend on the wave-lengths of the new rays. This property is possessed to a marked degree by many (but not all) specimens of flourspar, hence the phenomenon has been called fluorescence.

LOCUSTS AND THEIR CONTROL.*

By B. P. UVAROV, Senior Assistant, Imperial Bureau of Entomology.

FROM the dawn of civilization until the present time, locusts have constituted one of the most serious menaces to the development of agriculture in many parts of the world. In all continents without exception, and in many different countries, the inter-relations of man with these insects have assumed the character of a continuous struggle for the very existence of agriculture, and the victory has not always rested with man. In the great majority of cases this struggle has resolved itself into a series of desperate attempts to save at least a portion of the crops from destruction, and until quite recently there has been no chance for man to adopt a definitely aggressive policy against these insects. It is only as a result of the general progress of agriculture and the reduction of uncultivated areas which provide breeding grounds

* This paper is nothing more than a very brief and popular summary of present knowledge of the locust problem. The subject is discussed in full detail in a book by the author, which will shortly be published by the Imperial Bureau of Entomology.

for locusts that the problem in some few countries, such as western Europe or North America, has lost its permanency, and the invasions by locusts have become less regular, though still exceedingly dangerous owing to the increased value of crops. Other countries, such as the Sudan, South Africa, Russia, and South America, are at present either at the most critical stage, when the uncultivated areas furnish suitable breeding grounds for locusts while the crops are of great value, or else are only just beginning to feel the menace to their agricultural resources caused by locust attack.

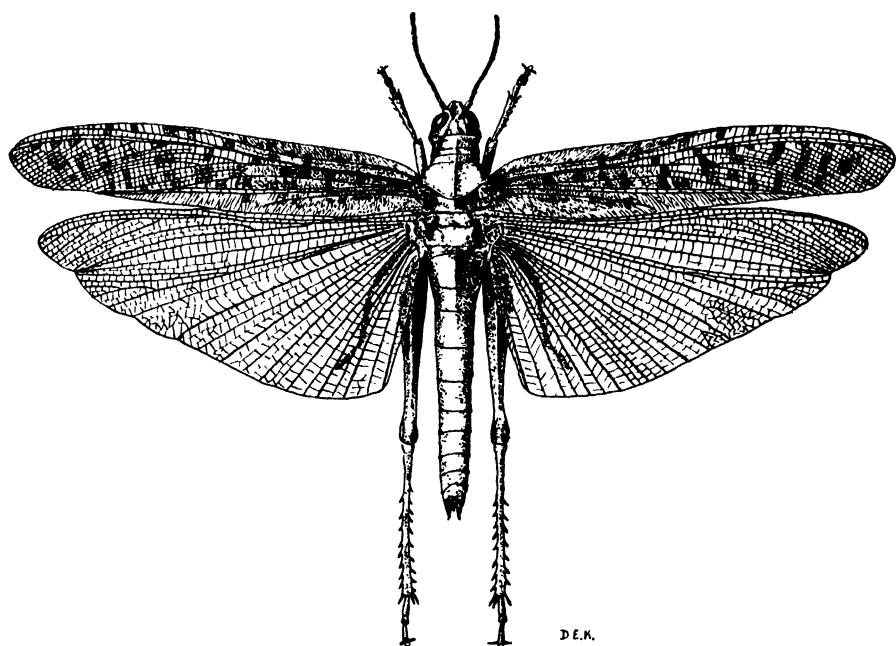


FIG. 1.—DESERT OR BIBLE LOCUST (*Schistocerca gregaria*).
Natural size.

Owing to the economic importance of locusts their structure, habits, etc., have naturally been the subject of research, and a considerable amount of information relating to various aspects of the locust problem has already accumulated; but unfortunately, as we shall see, our knowledge as regards some of the major points is still incomplete.

Under the name "locusts," in the strict sense of the word, are now understood such members of the family Acrididæ (order Orthoptera) as possess gregarious habits and form large migrating swarms; other Acrididæ, known as "grasshoppers," although

closely allied to locusts, are devoid of these habits. Thus there are no means of distinguishing a grasshopper from a locust apart from the difference in habits, and even this is not constant, since locusts, when they are not numerous, assume the same habits as grasshoppers (see below).

The outstanding features of the structure of a locust are clearly shown in the figure (Fig. 1) on the previous page. It will be seen that, like all other insects, a locust has three pairs of legs; those of the hind pair, however, are particularly strongly developed and serve for jumping. Two pairs of strong wings enable the

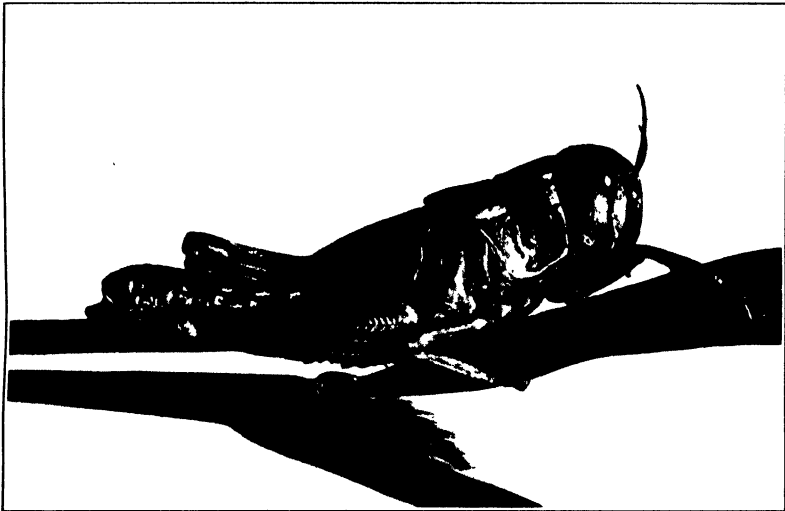


FIG. 2.—HOPPER OF MIGRATORY LOCUST (*Locusta migratoria*).
Greatly enlarged.

insect to traverse great distances in flight. These organs, however, are present only in the adults; the young insects, called "hoppers" or (in South Africa) "voetgangers," though resembling the adults in every other respect, have only rudiments of wings (Fig. 2). The head of a locust is provided with a pair of powerful mandibles, enabling the insect to attack plants.

The life-cycle of locusts is fairly simple. The eggs, in groups of about 30–100, are deposited by the female in the soil; they are often enclosed in an "egg-pod," a capsule formed of particles of earth glued together by a mucous secretion from special glands in the female. In countries with a temperate climate the winter is usually passed in the egg-stage, and the young hoppers emerge in the spring and appear on the surface of the ground. In the tropics the eggs may hatch in from a fortnight to three weeks, but



FIG. 3.—YOUNG HOPPERS OF MIGRATORY LOCUST (*Locusta migratoria*)
CLIMBING PLANTS IN ORDER TO PASS THE NIGHT.
Natural size.

this depends to some extent on the rains, which somehow stimulate hatching. Young hoppers soon collect into small dense groups, climb the nearest plants and commence to feed upon them (Fig. 3). Further development of the hoppers takes the form of rapid growth accompanied by periodic shedding of the skin (moulting); there are usually four or five moults separating the same number of hopper stages. A few weeks later comes the final moult, from which the hopper emerges as an adult. The whole cycle usually occupies a year, though in the tropics there may be more than one generation during this period.

The hoppers of all locusts exhibit a remarkable inclination to collect into dense groups called bands, which pass the night on plants, but in the morning are awakened by the sun, and begin feeding. Then one by one, when the sun becomes too hot, the insects climb or hop from the plants to the ground. With further increase in the temperature, hoppers become restless and make small jumps, and soon the whole band commences to move in the same direction. When two moving bands meet they usually form one larger band, which continues to move in the direction of the larger of the two. Such encounters results in the formation of enormously large bands, stretching for miles and blindly marching on. Picturesque descriptions of these great bands of hoppers abound in various books of travel. The relentless march of such masses of hoppers, regardless of obstacles, creates an impression of some dark purpose, of a movement towards an objective, and has led to numerous, more or less fantastic, explanations of the cause. All recent exact observations, however, definitely show that the movements of hoppers are entirely due to the influence of high temperature. Indeed, it has been found that the march of bands begins and ends at a definite temperature (about 59–62° F.), and a sudden drop in the temperature results in a stoppage of moving bands, which do not march at all on cool days. It is usually supposed that the movements of locust bands are caused by lack of food, and that the bands are migrating in search of nutriment; but the fact is that they often abandon an area where there is food in abundance, and move away into an open desert, impelled merely by heat.

When hoppers become adult and acquire wings, they no longer migrate on foot but use their wings instead, and great swarms of winged locusts undertake flights covering long distances. These migrations of winged locust swarms have also often been said to be due to the destruction of all food supplies in the breeding places, and the necessity of finding new foraging grounds; but in this case again the explanation does not agree

with facts, since it very often happens that locust swarms leave behind them rich vegetation and fly off into the desert, or even out to sea, where they all ultimately perish. A close study of the physiology of migrating locusts, which has recently been undertaken, has shown that migration is necessary for the maturation of the generative organs and is followed by pairing, after which the eggs are laid.

It is easy to understand that this habit of making prolonged migratory flights must often result in an unexpected invasion by locust swarms of areas in which there was no trace of them shortly before. Apart from the damage to crops which is caused in these cases by the invading swarms, the country may become infested with eggs, and the hoppers to which the latter give rise represent a still more serious danger to the crops of the following year.

An important feature of locust outbreaks is that they do not occur year after year, since years of very bad invasions are usually followed by an interval during which locusts are conspicuous by their absence. The reasons for this periodicity of locust invasions are still obscure, although some very interesting discoveries, indicating the way to further research, have recently been made in this field. It has been found that the progeny of locusts in years when numbers are small is non-gregarious, and differs considerably from migrating locusts in external appearance as well as in habits. The external differences between the swarming and non-swarming (solitary) forms are sometimes so pronounced that they have long been considered by specialists as representing entirely distinct species. As regards habits, the solitary forms of locusts are typical grasshoppers, *i.e.* they exhibit no inclination to form bands, or swarms, and do not migrate. It is only when the numbers of solitary forms in a given locality increase to a sufficient extent that the insects acquire different external characters, and, in conjunction therewith, the habits of true locusts. Thus, the same species may appear, in years when its numbers are at their lowest, as a common grasshopper, or, in years when it is most abundant, as a swarming locust. The two forms, termed respectively the solitary and the swarming phase, have now been found in nearly all species of locust.

Whereas the discovery of phases helps us to understand the sudden appearance of locusts (swarming phase) where only scattered and harmless grasshoppers (solitary phase) were previously found, it merely supplies a key to the solution of the problem of the periodicity of locust invasions, for the solution of

which further detailed investigations are necessary. The initial increase in numbers of the solitary phase is probably connected in some way with climatic fluctuation, but as to this nothing definite can at present be said. One point, however, is fairly clear, namely, that the transformation from the solitary phase into the swarming one occurs only when all circumstances are the best possible for the particular species of locust; and this condition is fulfilled only in special places, and in special years. Places where the production of the swarming phase is possible are known as permanent breeding grounds, and these differ widely in characters in the case of different species of locust. Thus, the Migratory Locust of Russia (*Locusta migratoria*) breeds only in reed-beds on the banks of large rivers; the Desert Locust (*Schistocerca gregaria*) has its breeding grounds in sandy deserts in north Africa, Arabia, Persia, and elsewhere. In the case of some species of locust the breeding grounds have yet to be determined, and exhaustive research is required, since the discovery of the breeding grounds is an essential preliminary to the successful control of these insects.

The age-long history of the struggle of mankind with locusts includes such an array of widely different means of combating the plague that a whole book would be required for their description. At present, however, the technique of locust-control is very simple, and the best of contemporary methods is the scattering of poisoned bait (wet bran impregnated with arsenite of soda), which both hoppers and adult locusts devour with avidity in preference to their ordinary food. In recent years aeroplanes have been employed to dust the insects and the plants on which they feed with fine arsenical powder; this method has also proved successful, albeit somewhat expensive and applicable only in sparsely populated areas. In any case, the difficulty of controlling locust-swarms, however large, has nowadays ceased to be a technical one, and consists entirely in the organization of control measures on a sufficiently effective scale. Special anti-locust organizations now exist in most countries which suffer from locusts; many of them, however, are inadequate for their purpose, and this is the real reason why the locust problem, which could be fairly easily solved, is still persistent. Indeed, in most countries, anti-locust measures are taken only when locusts appear in enormous swarms, and the situation has become well-nigh desperate. This should never happen if the national anti-locust organization is sufficiently good, and measures are taken to (1) investigate all possible breeding grounds; (2) keep them under constant observation; and (3) destroy all incipient swarms, thus preventing the

formation of the swarming phase. In this way the invasion of cultivated areas by locusts can easily be prevented.

There are, however, certain difficulties in the way of such a scheme, and one of them consists in the fact that there are still many points in the life-history of locusts which have yet to be investigated. For instance, the natural character of the breeding places of some species is still unknown, and the conditions causing the transformation of the solitary phase into the swarming one are also obscure. It follows that further research into the



FIG. 4.—HOPPERS OF MOROCCAN LOCUST (*Doclostaurus moroccanus*)
FEEDING UPON WHEAT.

About one-fourth natural size.

bionomics of locusts should be considered to be of great importance from the practical point of view; unfortunately, however, scarcely anything is being done anywhere in this direction. That this is so is due to the fact that in most cases the government of a locust-stricken country is satisfied with the possibility of averting wholesale destruction of crops by modern methods of control, and does not even attempt to solve the locust problem once for all by placing locust-breeding grounds under close study and observation, thus preventing the possibility of invasions. Until this is done in all countries subject to

devastation by locusts, the locust plague will recur again and again, in spite of the efficacy of modern anti-locust weapons. Entomologists have shown the way to the ultimate solution of the locust problem, and it rests with those responsible for the well-being of their respective countries either to follow the lead that has been given, or to continue the present system of averting periodical disaster at enormous cost.

RECENT IMPORTANT ALTERATIONS AND ACQUISITIONS.

THE large specimens of Spar (*v. supra*, pp. 258–265) from the Snailbeach Mine, Shropshire, have been placed in internally-lighted wall-cases in the Corridor outside the Mineral Gallery on the First Floor. In one compartment there has been installed the exhibit (*v. supra*, pp. 291–298) illustrating the fluorescence of minerals in ultra-violet rays.

* * * * *

Department of Zoology.

One half of an important collection of mammals and birds obtained by the Franco-British expedition to French Indo-China under the leadership of Monsieur Jean Delacour, with whom was associated Monsieur Pierre Jabouille, has been acquired. This expedition was the fourth of a series organized for the purpose of investigating the fauna of a region hitherto but imperfectly known. On the present occasion the British Museum was enabled by the generosity of Mr. J. Spedan Lewis to participate; and Mr. W. P. Lowe, a well-known collector who has served the Trustees in many lands, was sent out to assist with the collection and preparation of specimens. The collection has been evenly divided between the Musée d'Histoire Naturelle, Paris, and the British Museum. The latter's share comprises 151 mammals and 1794 birds, of which three mammals and twelve birds are forms new to science and are therefore of considerable systematic interest.

A fine specimen of the Bactrian or two-humped Camel (*v. supra*, pp. 273–275) mounted in the Rowland Ward Studios; presented by the Rowland Ward Trustees.

A series of 56 mammals, 230 fishes, and a small collection of parasitic worms from the Province of Santa Catherina, Brazil. They are of scientific value because they illustrate the fauna of a region at present imperfectly represented in the national collection.

Department of Mineralogy.

Crystals of uraninite (pitchblende) in pegmatite from a newly-discovered occurrence in Gordonia, Cape Province, South Africa; presented by Dr. Percy A. Wanger.

A series of specimens from the bauxite deposits of Kashmir; presented by the Superintendent of the Mineral Survey of Kashmir.

Honey-yellow crystals of barytes from an iron mine in west Cumberland; purchased. On exposure to daylight these curious crystals change within a few hours to green and afterwards to blue.

The Collection of Rocks has been augmented by the purchase, exchange, or presentation of specimens from Charnwood Forest and Mount Sorrel in Leicestershire, Hegau in Baden, Baluchistan, Natal, Zululand, British Cameroons, and Montana, U.S.A.

Department of Botany.

A series of 454 specimens of flowering plants collected by the donor in the Red Sea Province, Sudan; presented by Mr. P. E. Newberry.

BOOK NOTICES.

Leaf-Mining Insects. By JAMES G. NEEDHAM, STUART W. FROST, and BEATRICE H. TOTHILL. Pp. viii + 351, with 91 text-figures and 3 plates. (Baltimore: The Williams and Wilkins Company. London: Baillière, Tindall and Cox. 27s.)

ALTHOUGH a great deal is known of the structure and biology of the leaf-mining insects, the information has hitherto been scattered through innumerable scientific publications, many of which are difficult of access to the ordinary student. The authors are therefore to be congratulated on having produced the first comprehensive work on this subject.

The book is divided into three main sections. The first is devoted to a general introduction to the study of the leaf-miners. This is followed by a detailed account, so far as it is known, of the natural history of the more characteristic and important species arranged systematically. The third section consists of lists of leaf-mining insects and their hosts, together with a bibliography.

The introduction is somewhat superficial, and only a brief outline of the subject is given, possibly because, according to the preface, this section has been made intelligible to the general reader. It contains, however, much information of interest to the ecologist and general biologist, and also includes a table for separating the larvæ of the four orders of insects involved, and some brief notes on collecting and rearing larvæ.

The greater part of the book is occupied by the systematically arranged account of the natural history of the leaf-miners. Nine chapters are devoted to the Lepidoptera, in which order the leaf-mining habit is most widespread, and there is a chapter each on the Coleoptera, Hymenoptera, and Diptera. Although there is no indication on the title-page of the book, the names of the American publishers having been omitted, this section is based almost entirely on North American species, and, with few exceptions, only casual references are made to European and exotic forms. Tables of the more important leaf-mining genera of the world are, however, given in the sections on Coleoptera, Hymenoptera, and Diptera, but these are by no means complete, several genera containing important economic species having been omitted. In the Coleoptera alone, for example, no mention has been made of the West African genus *Calænomenodera*, or of the South American genus *Cephalolia*, species of which mine the young shoots and leaves of the oil palm on both sides of the South Atlantic. In the table of leaf-mining Dipterous genera, two Chironomid genera have been recorded, but are dismissed with the words "not true leaf-miners," and are consequently omitted from the subsequent list. Dr. Hering, however, gives as an example of a true leaf-mining Chironomid, *Cricotopus brevipalpis*, which actually feeds on the mesophyll of *Potamogeton natans*. Although the genus *Cricotopus* is mainly European, it is referred to in the table only as North American.

The list of leaf-mining insects is based entirely on North American species, the only European forms included being those which also occur in North America; even those European species mentioned in the text have been omitted. In the lists of both insects and host plants, each species is numbered, and in each list cross-references are given to the specific numbers in the other. The value of the book to the specialist would have been greatly enhanced if bibliographic references had been given in the list of insects, since, except for reference in using the table of host plants, a mere list of names is of little use. The concluding bibliography is fairly comprehensive on the biological side, but some important memoirs have been omitted.

Amongst a number of typographical errors noticed, two may be mentioned here. Fig. 2 does not represent *Lithocolletis hamadryella*, which is correctly shown in Fig. 43. The Gelechiid bulrush leaf-miner, *Aristotelia robusta*, is referred to on p. 152 as if it were a species of the Cynodiid genus *Aphelosetia*.

On the whole, although the authors have not been successful in their attempt to make this book both popular and scientific, it may be recommended to anyone desirous of gaining a general knowledge of the subject, in particular of the North American leaf-mining fauna.

The Elasmobranch Fishes. By J. FRANK DANIEL. Pp. xi + 332, with 270 illustrations. Second edition. 1928. (Berkeley, California: University of California Press. 27s. 6d.)

THERE is no modern text-book in the English language dealing specially with the morphology of the Sharks and Rays, and Professor Daniel, who is the author of several important papers on the skeleton of these fishes, is well qualified to supply this deficiency. Professor Daniel is to be congratulated on having produced a most attractive and interesting volume, which should be read by all workers on this group, and which should prove of interest and value, not only to the student, but also to the teacher of zoology. As the author points out in his preface, "the Elasmobranch fishes are . . . unsurpassed as material on which to study the fundamental plan of the vertebrate body."

The book provides a general account of the Sharks and Rays, which with the Chimæras and their allies (Holocephali) are now regarded as constituting a distinct class of vertebrates—the Selachians. Although treated largely from the morphological aspect, the relations existing between structure and habits are duly emphasized. The first chapter deals with the external form, and each of the ten succeeding chapters is devoted to a description of a system of organs, such as the integument, endoskeleton, musculature, nervous system, and so on. It is difficult to see how this method could be improved upon, but, at the same time, the reader who wishes to obtain information relative to the claspers (mixopterygia), for example, is obliged to seek this in at least four sections: the glands associated with these structures are described on page 28, the skeleton on page 75, the myology on page 105, and the function on page 310. Each chapter begins with a clear and concise description of *Heptanchus maculatus*, in many respects one of the most primitive of living Sharks, followed by a comparison with the more specialized Sharks and with the highly modified Rays. As the book is intended primarily for the use of American workers, the types studied are necessarily those which are most common on the coasts of the New World: many of them, however, occur in our own seas, or are represented there by closely allied species. Each chapter is concluded by a bibliography, which although adequate is not without one or two striking errors and omissions. One finds that Regan's paper on "The Classification of the Selachian Fishes," which contains a number of original observations on the endoskeleton, is included among a list of references headed "external form": in the section devoted to

the integument, and containing an account of the poison glands associated with the spines of the Sting Rays, the recent work of Evans on the anatomy and histology of these organs appears to have been overlooked.

Matters of morphological fact seem to be generally clearly and accurately stated, and the illustrations, many of which are the work of one of Professor Daniel's students, Mr. Duncan Dunning, are excellent. In his theoretical considerations of a more general nature, however, the author seems to be less sure of his ground.

1. *Report on the Palæontology of the Zanzibar Protectorate*, based mainly on the collection made by G. M. STOCKLEY, A.R.C.S., D.I.C., F.G.S., Government Geologist, 1925-26. Pp. 180, with 23 plates. 1927. (Government of Zanzibar. 21s.)
2. *Report on the Geology of the Zanzibar Protectorate*, by G. M. STOCKLEY, A.R.C.S., D.I.C., F.G.S., Government Geologist, 1925-26. With a Preface by E. J. WAYLAND, A.R.C.S., F.G.S., M.Inst.M.M., Director of the Geological Survey of Uganda. Pp. 126, with 5 plates and 3 maps. 1928. (Government of Zanzibar. 12s. 6d.)

(Both obtainable from the Crown Agents for the Colonies, London.)

THE geological survey of the Zanzibar Protectorate was carried out primarily to investigate certain economic questions, but the economic interest of the results has, as the two reports now before us indicate, been surpassed by their general scientific interest, and commendation is due to the Zanzibar authorities for undertaking their publication in the present attractive form, thereby setting an example to our other East African dependencies.

1. The fossils collected by Mr. Stockley have been placed in the Geological Department of the British Museum, where there were already specimens obtained from Zanzibar by Mr. J. T. Last and Mr. E. J. Wayland. All these, and one or two other collections from neighbouring regions, are discussed in the present important publication, which contains the first comprehensive account which we have of the fossils that occur in the Upper Tertiary rocks of East Africa. The most important results are brought out in a brief introduction by Mr. L. R. Cox; he shows that, now that the evidence from the various groups of fossils has enabled a closer determination of the ages of the various rocks to be made, some of them prove to be much older than had previously been suspected. Beds in the island of Pemba, formerly regarded as Pleistocene, are now assigned to the Lower Miocene; the rocks of Zanzibar Island range from Pliocene to Pleistocene.

The Lower Miocene rocks have yielded Foraminifera, described by Prof. A. Morley Davies, and a crab, described by Dr. C. J. Stubblefield. From the Pliocene come sharks' teeth described by Dr. Errol White. Molluscs and sea-urchins from all formations are described by Mr. Cox and Mr. Stockley respectively. We do not know if there is an editor: someone has to be thanked for a list of localities and an index; but no one has arranged that the authors should present their results in the same way. Each writer gangs his ain gait, and all we need say is that we prefer the method of Mr. Cox and, but slightly less, that of Dr. White. This is, however, hardly the place for criticism of such technical points. The whole volume really represents a large amount of hard work in field, laboratory, and study.

2. The present volume serves to show to how great an extent the progress of geological knowledge depends on the results of palæontological research, and it is quite appropriate that the palæontological volume should have preceded and paved the way for this one on the general geology.

After a short chapter on the physical conditions of the two islands, Mr. Stockley summarizes the observations of previous workers and then gives an account of the results of his own survey. The advance which his work constitutes may be realized by comparing the last previously published geological maps of Zanzibar and Pemba (those of Werth in his work "Das Deutsch-Ostafrikanische Küstenland und die vorgelagerten Inseln," Berlin, 1915) with those that accompany the present volume. The discovery, already referred to, of the true ages of the rocks of the two islands has dispelled the theory that they are coral islands of fairly recent origin, and has shown that they originated in quite different ways. Pemba owes its origin to faulting which occurred in Miocene times; it is a horst bounded on all sides by faults of considerable dimensions, being separated both from Zanzibar and from the mainland by very deep channels. Zanzibar, on the other hand, was connected with the mainland until a much later date, and its ultimate separation was the result of denudation. Wayland's view that the two islands have cores of igneous rock is not favoured.

An interesting application of the theory of "cycles of sedimentation" is made by Mr. Stockley in his account of the Lower Miocene of Pemba. It may also be noted that he has not neglected to make use of modern petrographical methods of examination of the sediments in drawing his final conclusions. Several pages are devoted to general questions concerning the correlation of Indian Ocean Neogene strata, and an important correlation table is included.

Unfortunately the Protectorate has proved to be poor in minerals of economic value. The reported occurrence of gold (one of the original reasons for the survey) has not been substantiated, and even "Zanzibar Copal" does not occur in workable quantities, although much of this commodity originating on the mainland is re-shipped from Zanzibar.

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Natural History Magazine

No. 9

JANUARY, 1929

Vol. II

THE KING CHEETAH.

By J. G. DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

THE Museum has recently acquired a fine example of the King Cheetah (*Acinonyx rex*) from near Salisbury, Southern Rhodesia. The specimen, which has been mounted in the Rowland Ward Studios, is now exhibited among the *Felidæ* in the Lower Mammal Gallery.

The King Cheetah was first described in the *Proceedings of the Zoological Society* for 1927 by Mr. R. I. Pocock, F.R.S., his description being founded on a skin sent home by Major A. L. Cooper, D.S.O. Major Cooper had previously sent a photograph of the animal to the Museum and to the *Field*; this photograph, together with Major Cooper's account, was published in the *Field* in October, 1926. In this account the skin is described as that of a hybrid between a leopard and a cheetah, having the proportions of a leopard, the non-retractile claws and neck-ruff of a cheetah, and a pattern quite unlike that of either animal. The photograph was too small to allow of detailed examination of the feet, nor could the presence of a ruff or mane be detected with certainty, and Mr. Pocock, in commenting on the specimen, remarked that whatever the animal was, it was not a leopard-cheetah hybrid, as had been suggested by Major Cooper; he further noted that it was probably an aberrant leopard. From time to time the most extraordinarily marked leopard skins have been sent home from Africa and Asia, and the markings of this skin did not appear to be very unlike that of some of the specimens previously examined. This is all the more understandable when it is remembered that skins of the King Cheetah, without feet and in poor condition, have undoubtedly come into the market from time to time and have been classified as unusually marked leopards. Major Cooper, not being satisfied that his animal was a leopard, sent the skin to the Museum for investigation; it was then at once evident, from examination of the feet, that the specimen was a cheetah and represented a new and undescribed species.

The skin of Major Cooper's specimen was obtained from natives by Mr. Donald Fraser, who presented it to the Pretoria Museum; inquiries were made regarding the existence of other specimens of this rare animal, and the result of these investigations was to bring to light the existence of four other pelts similar to the one sent to England. The original specimen was trapped by natives in the Umvukwe Range, north-west of Salisbury, Southern Rhodesia. A further specimen, in the possession of Mr. Lacey, of Salisbury, was trapped in the Siki Reserve, about twenty-five miles south of Salisbury, and information was received concerning another specimen shot in the Melsetter District, close to the Portuguese border; at one time, it is reported, these animals were fairly numerous and were known locally as the Mazoe leopards. Two further specimens were shot in the Bikita District in 1925. On the evidence of these five specimens, coming from different localities in Rhodesia, Mr. Pocock felt justified in describing this form as new to science, and gave it the name of *Acinonyx rex*.

The chief external differences between leopards and cheetahs are as follows:—the cheetah stands proportionately higher on its legs than a leopard, and the head is considerably smaller. There is a well-marked mane and ruff in the cheetah, which is lacking in leopards; in addition, the black stripe which extends from the front corner of the eye to the mouth is only present in the former animal. In leopards the "whiskers," or mystacial vibrissæ, are long and stout; in cheetahs they are either absent or very slender. The white colour of the underparts is unspotted in the cheetah, whereas the belly of a leopard is fully spotted. The most important difference between the two animals lies in the structure of the feet, a difference that is undoubtedly of generic importance, and probably may be regarded as evidence for separating the genus *Acinonyx* from that of the Cats and Lynxes (*Felis*, etc.) and creating for it a special subfamily, the *Acinonychinae*. Unlike all species of cats and lynxes the cheetah is unable to withdraw its claws owing to the absence of protective sheaths, and thus the points of the claws remain exposed, much as in a dog. The chief differences between the feet of leopards and cheetahs have recently been outlined in some detail by Mr. Pocock in the paper mentioned above, and in the *Annals and Magazine of Natural History* (Ser. 8, 1916, vol. 18, p. 419). In the cheetahs the claws, with the exception of the "dew-claw," are shorter and straighter than in the leopards, the latter having them longer and more hooked. The "dew-claw" of the fore-foot, in the cheetah, is larger than those of the

other digits, and, moreover, this claw is hooked and sharp, like the claw of a leopard's foot; probably it is used in striking



KING CHEETAH.

Height, 2 ft. 1 in. at shoulder.

down the animal's prey. In leopards it is a little smaller than the others. In the cheetah there are no flaps of skin on the digits to form protective sheaths for the claws when retracted;

in the leopard, and all typical cats, these protective sheaths are always present.

The common cheetah of Africa and India is a spotted animal; but in *Acinonyx rex* the spots run together to form stripes. The type specimen, in the Pretoria Museum, is more heavily and handsomely marked than the one under review; the blotches on the flanks becoming confluent and thus forming longitudinal and oblique bars. The central part of the back in the King Cheetah is marked by bold, longitudinal stripes, which extend from the neck on to the tail, the latter having two well-marked, longitudinal stripes dorsally in its proximal half; the distal portion is marked with broad, transverse bars. In the latter respect alone, *Acinonyx rex* resembles the common cheetahs in design. *A. jubatus* (Africa) and *A. venaticus* (India) are both marked with small, solid black spots; the only trace of a stripe in these species is the cheek-stripe, mentioned above, which appears to be a generic character. The ground colour of all these animals is a sort of pale buff tint, sometimes washed with tawny, sometimes with grey; the underparts are, as already stated, white or yellowish white. The various skins of *A. rex* which have been examined are each a little different from the rest, some being more heavily marked, the striping being the dominant feature of the pattern, others showing a tendency towards spotting on the flanks. As with leopards and servals, and other spotted cats, no two specimens appear exactly the same; this is true of nearly all mammals which exhibit striking body-markings. For instance, with such animals as the tiger, clouded leopard, ocelot, bongo, eland, bushbuck, zebra, okapi, and giraffe, a great deal of individual variation is always met with; sometimes, as among the bushbucks, this has misled the more enthusiastic systematic zoologists, with the result that many so-called new species have been founded on these individual characters.

The name "cheetah" comes from a Hindustani word "chita," which, like its Gond equivalent, "chitra," simply means spotted, and, in many parts of India, is used for the leopard. The same word is found in the native name of the Indian spotted deer, or "chital." Some authors, because of this confusion, prefer the name "hunting-leopard" for the cheetah, but here there is also ground for objection as the cheetah is not a leopard of any kind; in fact it may be regarded, as already indicated, as the representative of a subfamily quite distinct from the *Felinae*, or true cats. "Hunting-serval" is another name which has been suggested, but here again one can

argue that this beast has little relationship with the servals of Africa. The name "Guepard" was used by some of the older writers, but is now quite obsolete. The name most commonly used is undoubtedly the English form of the Hindustani chita, *i.e.* cheetah, sometimes cheeta.

The geographical distribution of the cheetahs is very extensive; not only are they found over a very large part of Africa, where they range from Nigeria to the Sudan, and southwards to Cape Colony, but they spread eastward through Palestine and Syria to Transcaspia, Russian Turkestan, Persia, and a large part of south-central India. They are not found in Ceylon or down the Malabar coast. In many parts of India, where cheetahs were formerly numerous, they are now quite rare. The African and Indian cheetahs, although usually considered to represent distinct species, are really very closely allied.

As a general rule these beasts do not attack man, and very seldom interfere with domesticated animals, occasionally killing a young goat or two. They are probably some of the fastest animals, for a short distance, in existence; blackbuck, which good greyhounds are unable to overtake, are successfully pursued, a cheetah being able to give one of these antelopes a hundred yards start and catch it in another two hundred. The general build of the animal clearly illustrates the stream-line construction, and the long legs, slender body, great depth of chest, and non-retractile claws are all features associated with speed.

Cheetahs were at one time largely used in India for hunting antelopes; they were caught when adult, so that they would have had the necessary parental instruction in hunting. If captured as cubs they never acquire the speed and power necessary for coursing and killing such fleet-footed animals as blackbucks. When hunting with a cheetah the animal is hooded and tied on a cart; when the game is sighted the hood is removed and the beast released. If the quarry is near at hand it is overtaken almost before the danger is detected; if within three or four hundred yards it is often secured with ease, notwithstanding the great speed developed by the blackbuck and gazelles. Sometimes a cheetah will approach the game by stalking until within a few yards distant, and then make a terrific rush at its selected victim, almost as though it had been shot out of a catapult. In the wild state they usually hunt in pairs, but instances have been recorded where whole family parties have been found hunting together; as a general rule, if their game is not secured in the first rush it is abandoned. They are reported to be very greedy

feeders, requiring several days to rally from the effects of their excesses. Young cheetahs are clothed in long and uniformly grey-coloured coats; the spotting is not noticeable until the shorter, under-fur is examined.

Fine specimens of the common cheetah measure two and a half feet in height at the shoulder and about seven feet in total length, some two feet six inches of this measurement being taken up by the tail. *Acinonyx rex* is apparently about the same size, Major Cooper's and Mr. Lacey's specimens measuring respectively six feet eight and six feet eleven inches in total length. The mounted specimen here illustrated stands two feet one inch at the shoulder, and it is probably not a very large example.

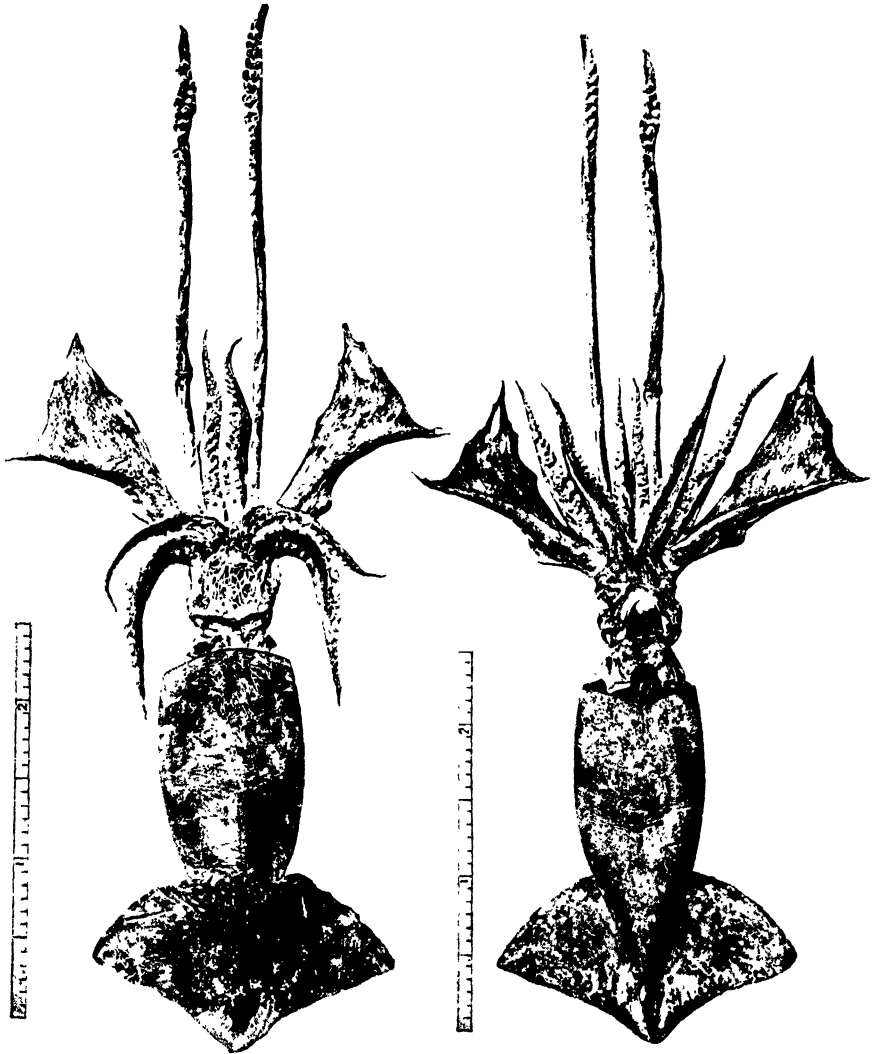
A GIANT SQUID FROM THE NORTH SEA.

By G. C. ROBSON, M.A., Assistant Keeper, Department of Zoology.

OLIVER GOLDSMITH in his "Animated Nature" (1774) rightly held that "to believe all that has been said of the Sea Serpent or the *Kraken* would be credulity; to reject the possibility of their existence would be presumption." It is now generally believed that the Kraken, a sea monster reputed in Norse folk-stories to live off the Norwegian coast, was one of the Giant Squids of the North Atlantic. These enormous molluscs (members of the class Cephalopoda) probably have their headquarters far out in mid-ocean; but for a long time information has been accumulating as to their occurrence, usually in a moribund condition, on the coasts of Western Europe, from Norway to Portugal.

The animals which best deserve the name "Giant Squid" belong to the genus *Architeuthis*. They are the largest invertebrate animals, a specimen of *A. harveyi* (?) being recorded as 52 feet in length (inclusive of the long tentacles). We may, however, include as Giant Squids the representatives of another genus, *Sthenoteuthis*, which sometimes attain to a total length of over seven feet. These animals have been caught on the coasts of England, Scotland, and Ireland; but up to the present specimens of the genus *Architeuthis* have been discovered only at places on the Scottish and Irish coasts. The occurrence of these monsters in British waters is being studied, and until all the records have been carefully examined it would be unwise to discuss the cause of their intermittent appearance on these shores.

There does, however, in the case of the genus *Sthenoteuthis* appear to be a focal area of occurrence on the coast of Yorkshire, between Spurn Head and the mouth of the Tees, the majority



Sthenoteuthis caroli.

(Reproduced by permission from *Proc. Zool. Soc.*, 1925.)

of the specimens having in recent years been stranded in the neighbourhood of Scarborough. It seems likely, therefore, that the animals come in from the Atlantic through the Pentland Firth or the Orkney-Shetland Channel, are carried southwards

through the North Sea, and, getting into difficulties, possibly owing to the lack of proper food or the lower salinity of the southern part of the North Sea, are cast ashore in an enfeebled condition at the point where, as is known from hydrographical observations, the movement of the southward-flowing Atlantic water finally spends itself.

Recent observations seem to show that the majority of the strandings take place in the winter months. It was, indeed, during a strong January gale in 1925 that the specimen illustrated in this article was washed ashore at Withernsea, ten miles north of Spurn Head. Thanks to the promptness of Mr. F. Needler, of Hull, and Mr. E. Noble, Coastguard at Withernsea, the specimen was obtained for the British Museum. A second specimen was observed "apparently dead" off Tunstall, four miles north of Withernsea; attempts were made to secure it, but it was washed out to sea.

The Squid obtained in 1925 is a large specimen of the very rare species, *Sthenoteuthis caroli*, measuring 7 feet 1½ inches in total length. Previous to this discovery the species had been known only from three examples stranded on the coast of Portugal and one caught in the Farøe Channel. There is a seventeenth-century description of a large Squid stranded on the Dutch coast at Scheveningen in 1661 which may have belonged to this species.

The most remarkable feature of this animal is the curiously expanded web of the third arms. This measures nearly a foot at its deepest and is shaped rather like a lateen-sail. As far as we know at present such an exaggerated development of the web of a single pair of arms is unique among the Decapod Cephalopoda. Its function is at present unknown.

ICHTHYOSAUR EMBRYOS.

By W. E. SWINTON, B.Sc., Assistant Keeper, Department of Geology.

THE occurrence of skeletons of adult ichthyosaurs in close association with the remains of small, but similar, individuals, if not common, is at least not very rare and has been known for many years. Most of these specimens have been obtained from the famous fossiliferous limestones of Upper Liassic age quarried at Holzmaden in Würtemberg, and the best and earliest known of them are preserved in German museums, particularly in the Naturaliensammlung in Stuttgart. One Stuttgart specimen is

especially fine; its cast in plaster, recently purchased for the Natural History Museum, is now on exhibition in the fossil reptile gallery of the Geological Department. The cast shows not only a very good skeleton of an adult ichthyosaur, but also a very fine skeleton of an embryo, which has apparently just issued from the pelvic region of the mother—indeed, two-thirds of its snout are still within the body cavity (Fig. 1). The little skeleton is somewhat distorted and slightly displaced, but very few of its bones are missing, and it is probably one of the finest embryos yet discovered. The length of the parent is seven feet, the head itself being eighteen inches; the embryo is two feet long, including the eight-inch skull. The comparatively great size of the skull with its relatively enormous eye (two



FIG. 1.—*Ichthyosaurus quadriscissus*. PLASTER CAST SHOWING ADULT WITH FOUR EMBRYOS (R. 5463).

inches in diameter) is, of course, a common embryonic feature. Within the body-cavity of the mother there can be seen the fragmentary remains, principally the snouts, of three other embryos. Apparently they are of the same size as the first. All have their heads pointed towards the head of the mother. Near the specimen in the Reptile Gallery is to be seen another, but original, specimen from Holzmaden, which shows the bony rostra or skulls of six embryos in various parts of the abdominal cavity (Figs. 2 and 3). The length of the skulls does not exceed eight inches and all are pointing towards the tail of the mother. The specimens in our collection can, therefore, be used to illustrate almost every condition in which these embryos are found.

The first recorded specimen of a young ichthyosaur within the body of another is preserved in Stuttgart, and was figured by Jäger in 1824, and again in 1828. Beyond calling it "rostrum animalis minoris," he made no mention of it, and failed to

appreciate its significance. No attention appears to have been paid to the subject until 1846, when J. Channing Pearce, an English physician, published a paper on an embryo in *Ichthyo-*

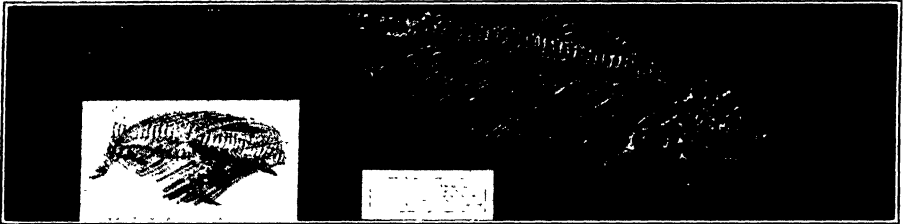


FIG. 2.—*Ichthyosaurus acutirostris*. ADULT WITH SIX EMBRYOS (R. 3300).

saurus (?) *communis*. Channing Pearce had obtained a large skeleton in the Lias of Somerset which, on being cleaned up, had revealed the skeleton of a little ichthyosaur only five and a

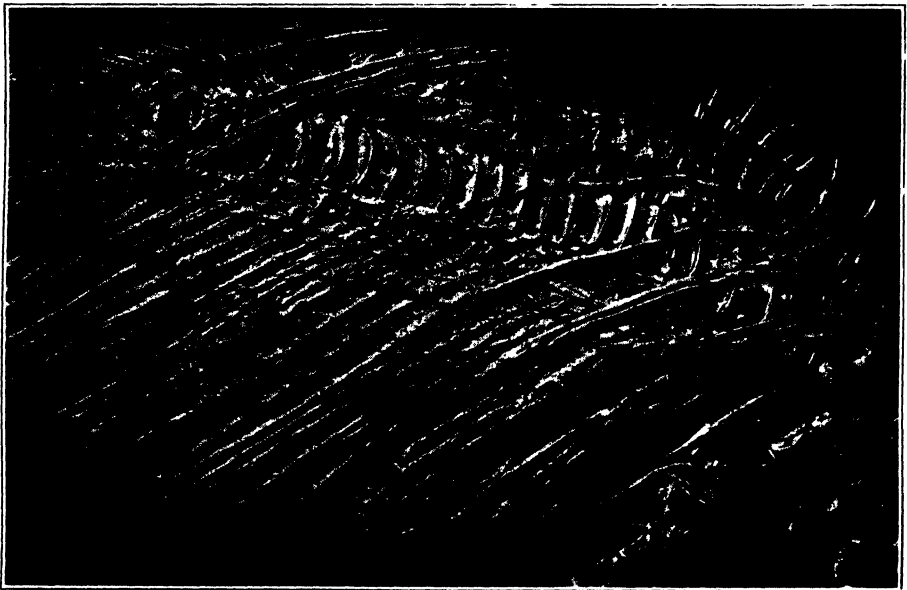


FIG. 3.—*Ichthyosaurus acutirostris*. THE EMBRYOS.

half inches long. He declared that so delicate a skeleton could not possibly have been part of the adult's food, because the gastric juices would undoubtedly have destroyed it, and he concluded that it must be an embryo, and the ichthyosaurs viviparous. This paper awakened interest in the subject, and three theories were eventually raised to account for the position

of these little skeletons. In order to appreciate these theories it is necessary to point out the various conditions in which the little specimens are found. The position of the young in the two specimens in our collection has been described, but a similar variety exists in the historic German specimens. Earlier in the year the writer had the opportunity of studying the whole of this material. In Stuttgart there are, besides the original of our new cast, three other specimens showing embryos and labelled as *Ichthyosaurus quadriscissus*. One of these has a single embryo with its skull pointing backwards in the hinder region of the adult's body; another has a single embryo directed anteriorly in the middle of its body; the third has its seven young quite forward in its body, and all the little skulls are directed towards the mother's head. The Munich example, also *Ichthyosaurus quadriscissus*, has the head of the embryo pointed towards the mother's head. Two embryos belonging to the same species, and in the Tübingen collection, lie in the hinder part of the adult's abdominal cavity, and point backwards. The Senckenberg Museum in Frankfurt-on-Main has a specimen of *Ichthyosaurus crassicostatus* with a young one preserved in the thoracic region and its head directed towards the parent's head. It will be seen, therefore, that these young ones occur in almost all positions and in any part of the adult's abdominal cavity. Now, in the higher vertebrates, where the young are produced alive, the general rule is that the head is born first. There are exceptions to this rule, but the ichthyosaur embryos appeared to be found too often in the exceptional position for their true nature to be realized at once. As the majority of reptiles are egg-laying, the theory was advanced that the little skeletons found in the large ichthyosaurs were the remains of food; and this theory, which counted Owen and Quenstedt among its supporters, held sway for a long time. Weighty objections can, however, be made against it. It seems strange that the abdominal cavity should not contain the other articles of ichthyosaurian diet, squids, belemnites, fishes and the like, also in a good state of preservation. We know nothing of the splanchnology of the group, but the coprolites preserved would seem to indicate that the intestines would not allow such large bodies to pass very far back. Further, it seems unbelievable that so many as six or seven of these little individuals, taking up more than half of the adult's visceral capacity, should have been necessary for an occasional meal. Finally, it is crediting the ichthyosaurs with too fine a taste and discriminative power to assume that they ate small specimens of their own

species only; for in every case where identification is possible the little animal belongs to the same species as the adult. Against these objections is the one fact that most of the young appear to have been swallowed tail first by the pursuing adult; but that seems to carry little weight.

In 1865, almost twenty years after Channing Pearce's paper, Professor Houghton of Dublin put forward the suggestion that the ichthyosaurs went through "metamorphoses, like the Batrachians." As his conclusion was based on an embryo which had obviously lost its limbs, no particular attention has ever been paid to the suggestion. In 1880 Professor Seeley laid the conclusions of a Committee, appointed to investigate the question, before the British Association at Swansea. His Committee were of the opinion that the young were truly embryonic, and that the ichthyosaurs were viviparous. This view is now generally accepted.

The ichthyosaurs were reptiles especially adapted for oceanic life, and viviparity would have been of immense value to them, as it dispensed with the need for return to shallow waters or coastal places. Nothing is known of the period of gestation in these reptiles, but possibly it was several months. If the mother died during pregnancy, and sank in the comparatively quiet deeps, the body, on decomposition, would allow the embryo skeletons to assume, in or near the adult's skeleton, just those positions in which they have been found, that is, in almost any position in the abdominal cavity, and orientated in almost any direction. Where several little skeletons occur it is probable that the limits of space prevented their adoption of different attitudes.

The comparative quiet of the waters in the ichthyosaur's resting-place, and the gentle deposition of the materials which ultimately formed the limestones over it, have led to the excellent preservation of many of the little skeletons.

In the specimen recently added to our collection, the most complete embryo of the four to be seen is apparently just issuing from the pelvic region of the mother; but it is very doubtful that it was being born, and its position is almost certainly due to post-mortem influences. It is well worth inspection, if only on account of the excellent preservation of the various bones, even of the abdominal ribs.

Both the Museum specimens are to be seen in Wallcase 15 on the south side of the main Fossil Reptile Gallery (No. 4) in the Geological Department.

PRESERVATION OF OUR NATIVE FLORA.

By A. B. RENDLE, M.A., D.Sc., F.R.S., Keeper, Department of Botany.

IT is encouraging to note the increasing interest that is being taken in the preservation of the native flora in various parts of the world, where its existence is threatened by growth of population. A vigorous campaign is carried on in the United States of America by the Wild Flower Preservation Society, which has its headquarters in Washington, D.C. The Society's Christmas appeal, which has just been received, urges discrimination in the selection of "Christmas Greens" for decoration. For instance, the use of cultivated English Holly, which is grown in large quantities for market, is enjoined in the place of the fast-disappearing American Holly; English Holly, moreover, is to be preferred to the American, the leaves of which have not the glossy sheen of the Old World species.

The feelings of many plant-lovers in our own country have been aroused by, or perhaps one might say, have found expression in, a little book recently issued by Mr. Henry Salt entitled "Our Vanishing Wild Flowers." The book is in part a reprint of articles contributed by the author to the *Times* and *Fortnightly Review*, calling attention to the various agencies that are concerned in the disappearance of our wild flowers. In an "afterword" to the volume, Sir Maurice Abbot Anderson, C.V.O., advocates the formation of a League for the Preservation and Protection of our wild flowers, and generously offers to undertake, with assistance, the work attendant on the establishment of the League.

It is natural that views as to methods of procedure should vary. Presumably all plant-lovers are agreed as to the desirability of stopping the extensive uprooting of plants, such as primroses or ferns, for private greed or public sale. Steps have been taken by the Society for the Promotion of Nature Reserves to enlighten the public by means of posters. For some years by-laws have been in force in many counties, but they have had a restricted application to the public highways. Recently a more extensive by-law has been approved by the Secretary of State for Home Affairs and has already been adopted by the counties of Cumberland and Hertfordshire; it runs thus:—

No person shall (unless authorized by the owner or occupier, if any, or by law so to do) uproot any ferns or other wild plants growing in any road, lane, roadside waste, roadside bank or hedge, common, or other enclosed place to which the public have access.

This by-law, where properly enforced, will check these practices and will also protect the less common plants which attract the plant-collector and nature-student.

The preparation of a list of scheduled plants whose gathering would be prohibited by law has been considered in this country, but up to the present has not been adopted, partly on the ground that it would call attention to the rare species. Such schedules are, however, in use on the Continent of Europe, and in the United States.

The interest in the preservation of our native flora has found expression among some plant-lovers in a desire to replace species which have become extinct or even to introduce plants of our rarer species in apparently suitable places. The latter point of view was expressed by Mr. C. B. Tahourdin in a letter to the *Journal of Botany* (August, 1928), in the course of which he writes as follows :—

A suggestion has sometimes been made that the preservation of vanishing species might be helped if seeds of the rarer native plants were sown in suitable spots in the wild, the habitat of such species being thus extended. I have recently seen an instance where this has been done, and the experiment seems successful.

The suggestion looks excellent and there seems to be only one objection, and that is, that the appearance of the species in a spot where it was previously unknown may puzzle students, but after all the question is one not solely for students but for the whole community—indeed, it is a national question.

To meet this difficulty, a Central Botanic Authority might inaugurate a register in which would be recorded, so far as possible, all cases in which seeds had been sown in the wild, with full particulars as to date, locality, species, and any other matters that might be deemed useful, and, subject to official approval and supervision, students would have access to the register.

Sowers of seeds would be encouraged to register the necessary details of sowings and to send records of results. There is probably very little precise information available now as to seeds sown in the wild, but the practice does and will exist, and it might be hoped ultimately to bring it under control, and even give direction and assistance.

In inviting expressions of opinion on the subject I pointed out that the question is not one of preserving or restoring amenities: such, for instance, as rehabilitating areas around a large town which have been stripped of their former population of ferns, primroses, cowslips, and other species generally attractive to the public; but of extending the range of our rarer species. It means, in fact, making man a conscious factor in problems of geographical distribution, and students of this subject may not welcome the addition of this uncertain factor. There is a danger also that, unless the seed which is sown is from British-grown plants, forms new to the flora may be introduced.

Moreover, the interest associated with the occurrence of a rare plant depends mainly on its rarity and the problems suggested by that rarity, and that interest would be seriously diminished if its occurrence were due to conscious human agency.

Whatever views may be taken as to the desirability of the suggestion, there can be no doubt as to the importance of keeping a careful record of such happenings, and the Department of Botany of the British Museum, one section of which is devoted to British plants, would seem to be the most suitable place for the record.

Sir Maurice Abbot Anderson agreed (*Journ. Bot.*, October) with Mr. Tahourdin, if by a "suitable spot" is meant a *known* station of some rare species where that species from any cause or causes is gradually dying out or has died out. As an example he records his re-introduction of the Royal Fern in an original locality near Lyme Regis from which it has been missing for some five years. He also suggests precautions to be observed in the sowing of seed of rare species in suitable spots. We understand, however, that Sir Maurice, appreciating the difficulties that may arise for the student of plant-distribution, is now convinced that such sowing is undesirable.

The view of the majority of botanists is, I venture to think, expressed by Miss Eleanor Vachell, Secretary of the "Flora of Glamorgan," from whose letter in the November number of the *Journal* I take the liberty of quoting the following passages:—

Field-botany should be viewed as a study to be pursued in relation to other sciences, geology, entomology, etc., for plants are dependent on soil and climate, and on birds, animals, and insects, for seed-dispersal and pollination. In this way it plays an important part in helping to throw light on problems of the earth's past history, which can only be solved by the co-operation of students in all branches of science and by the recording of details which may appear unimportant, but may be invaluable when added to others. While some regard the disappearance of a rare plant merely as a passing sorrow, easily rectified by the planting of fresh material, others who realize the interdependence of plants, animals, and insects regard it as a calamity, for to them a plant established in an artificial habitat has no scientific value. Their interest lies in ascertaining the cause of its disappearance, such as the improved drainage of the land, changed climatic conditions, or the loss of some insect which formerly pollinated it. This knowledge is difficult enough to acquire, yet one man with a handful of seeds promiscuously scattered may upset in five minutes theories which have taken years to formulate.

By observing the climate, soil, elevation, and plant-associations of a district, a keen field-botanist delights in guessing what rare plants ought to be found there, and then in proving himself correct by finding them. This interest would be gone if promiscuous planting were encouraged.

Those who uproot destroy, and the trouble is finished, but those who plant create problems for the future. As Secretary of the "Flora of Glamorgan" I

know something of the difficulty. About twelve years ago a flower-enthusiast wrote to me saying that she and a friend had climbed the Brecon Beacons and had planted a few incrustated saxifrages in an almost inaccessible gully. My reply, expressing my views on the matter, brought an apology and an assurance that no one was likely to find the saxifrages in such a remote spot. Years passed and the incident left my memory. Last summer, however, two well-known botanists climbed the mountains and discovered the plants. The matter was mentioned to me and I produced the correspondence, to the disappointment of the botanists, who thought they had made a valuable new record. Such is the trouble caused by a misplaced desire to beautify nature.

Those who for kindly or æsthetic reasons wish to beautify the country for the sake of others would surely do better to subscribe to the National Trust for the Preservation of Nature Reserves.* The native flora of Britain should be regarded as a heritage to be jealously guarded against human interference.

A SPIRAL PUZZLE.

By L. R. Cox, M.A., Assistant Keeper, Department of Geology.

DEPOSITED many millions of years ago in a large freshwater lake which covered what is now south-eastern England, the sandstones and clays of the Wealden formation have long been known to be rich in the remains of huge and strange reptiles of a past era—perhaps the most familiar of all is that erect, kangaroo-like giant, the *Iguanodon*. Probably the most surprising discovery that has ever been made in these rocks, however, is that of the huge spiral bodies which are the subject of the present article. In shape very much like the casts of gastropod shells, but in their gigantic size—over seven feet in length—quite incomparable to anything found previously in rocks of any age or country, these objects will long remain a puzzle to the geologist.

To the north of Alexandra Park, Hastings, near the Old Roar Glen, there is situated an old quarry which, since the time of Mantell, has been famous as a prolific source of *Iguanodon* bones and other fossils. Here it was that the first fragments of these spiral bodies were found some thirty years ago, and brought to the notice of Mr. W. J. Lewis Abbott, the well-known local geologist. These fragments were, however, too incomplete to do more than arouse curiosity, and it was not until 1921, when a new road was being made in the vicinity, continuing St. Helens Road, and emerging at the junction of Sedlescombe Road North and Silverhill Park, St. Leonards, that light was thrown upon

* The correct title of this body is the National Trust for Places of Historic Interest or Natural Beauty. The Society for the Promotion of Nature Reserves is a distinct organization, which, however, works in close co-operation with the National Trust.

the matter. The construction of this road necessitated the excavation of a cutting through beds of the same horizon as those found in the quarry, that is, the lower part of the Wadhurst Clay division of the Wealden formation. At first, underlying the Drift, came beds of decomposed clay-ironstone, fissile sandstone, and red and blue clay. When these had been cleared away, a much harder stratum was reached, consisting of 15 feet of ferruginous sandstone and bedded masses, as well as numerous large, botryoidal concretions of "bluestone." *

It was among the material blasted from this stratum that Mr. G. F. Miller, the engineer-in-charge, was surprised one day to discover a spiral object, a foot and a half in length, reminding him of that well-known fossil, the "Portland Screw." Further investigation showed that this was merely the apex of one of several huge spiral bodies which lay in a horizontal position in the stratum (apparently about eight were met with in all). Unfortunately, owing to the fact that the strata at the spot were affected by a small faulted anticline, these bodies were fissured in places, and naturally they had not been improved by the quarrying operations. Nevertheless, Mr. Miller, realizing the interest of his discovery, got together as many of the fragments as possible, and succeeded in assembling three complete spirals, ready for removal to the Hastings Museum. Meanwhile, however, advice had been sought as to the scientific importance of the find, and, alas, an expert had dismissed these extraordinary spiral bodies as concretions of no particular interest! Enthusiasm flagged, the assembled fragments were neglected, and no attempt was made to save further specimens. To make matters worse, the local inhabitants, seeing the strange spiral bodies spread out by the roadside, decided that they would make excellent rockery stones; consequently, the specimens began to disappear mysteriously and, had it not been for the efforts of Mr. Lewis Abbott, all might have been dispersed in this manner. Ultimately, the local authorities decided to send what material remained to the Natural History Museum for expert examination, and its study was undertaken by Mr. B. B. Woodward.

Of the numerous fragments which had been recovered, it was found that six represented the major portion of one individual, coiled dextrally like most univalve shells, and a second individual, coiled sinistrally, was represented by three fragments, one of

* "Bluestone" is the local name for a hard bluish calcareous grit, which is quarried for road-metal; it is also known as "Tilgate stone."

which (that first found by Mr. Miller) consisted of the seven earliest whorls complete. A number of other fragments evidently belonged to other individuals. Plaster casts were made of the fragments of the most complete individual and, under the direction of Mr. Woodward, the construction of a restoration of the original spiral was carried out. This is the large cast now exhibited (Fig. 1), the restored portion being left uncoloured.

As reconstructed, this spiral body is 7 ft. 3 in. in height and consists of twenty-three whorls entirely in contact and increasing in diameter from about 4 inches near the apex to 14 inches at the other end, the rate of increase being somewhat more rapid in the earlier whorls. The actual apex, fortunately preserved, consists of a rather prominent rounded nucleus very similar to that of a gastropod shell, although larger in proportion than is usually the case. The first succeeding whorl is about $2\frac{1}{2}$ inches in height and the penultimate whorl of the whole spiral about 6 inches. Careful measurement of the rate of increase in height has led Mr. Woodward to the important conclusion that the law of increase is that of a logarithmic spiral, a type of spiral characteristic of gastropod shells in general. Certain irregularities in the coiling are apparent in the later whorls, but where the height of one whorl differs from the calculated amount, this divergence is compensated for by the next. Most of the whorls are rounded, but some are obscurely angular at the periphery.

By the side of the large reconstructed individual is exhibited a cast of the above-mentioned sinistral apex (Fig. 2; the original is the property of the Hastings Corporation Museum). This, the best of all the recovered fragments, is a remarkably regular spiral, which also complies with a logarithmic rate of increase. Attention may be called to certain differences between the measurements of this specimen and those of the dextral one. The seven sinistral whorls have a total height of 17 inches and the last is 7 inches in diameter. In the dextral specimen only five whorls occupy the first 17 inches and, although the nucleus is of about the same size as that of the other specimen, the diameter at this height is 8 inches, and hence the spire is not so acute.

It is, however, when we turn from a study of the apex of one of these spiral monsters to that of its last whorl that an observation, at first sight rather disconcerting, may be made. Unfortunately the last whorl of the restored dextral specimen has not been preserved complete, nearly half having been broken away by a longitudinal fracture; hence it is impossible to say definitely how this spiral ended. A small fragment of the

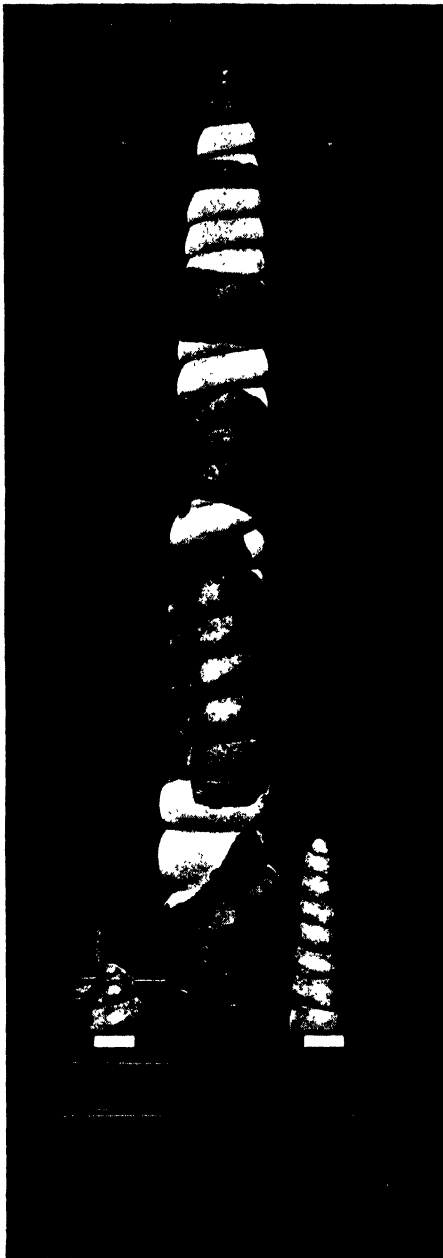


FIG. 1.—*Dinocochlea ingens*. Restored plaster cast, 7 ft. 3 in. in height, as exhibited in Gallery 8 of the Department of Geology. In front are shown the actual apex of this specimen, and the apex of a sinistrally coiled specimen. (Cast constructed by Mr. F. O. Barlow.)



FIG. 2.—THE SINISTRALLY COILED APEX.



FIG. 3.—A SINISTRALLY COILED SPECIMEN, SHOWING THE APERTURELESS TERMINATION.

penultimate whorl adheres to the last whorl, but, partly owing to the firmly attached matrix, only a very short length of the suture between them is visible. On the other hand, the last four whorls of a sinistral specimen (apparently not the same individual as that to which the seven apical whorls belonged) have fortunately remained undamaged. In this specimen (Fig. 3), although the spiral coiling is quite regular until the penultimate whorl, the last suture, at first inclined from left to right, corresponding with the sinistral mode of coiling, rises again and unites with the penultimate suture, the extremity of the whole body being rounded off and showing no free end of the last whorl such as would correspond to the cast of the aperture of a shell. A study of the preserved portion of the last whorl of the dextral specimen described above suggests that this may have ended in a similar manner, the spiral, as it were, sealing itself up.

The actual material of which these bodies now consist is a soft reddish-yellow ferruginous sandstone, sometimes, where the diameter is greatest, with a core of the hard bluestone, of which the yellowish material is obviously an alteration-product. Fractures show that the general mineralogical structure is parallel to the surface of the spiral, the material sometimes being arranged in layers of differing colour, forming rings on fracture-surfaces which are perpendicular to the axis. On the surface of the whorls, curved concentric markings are frequently visible (compare Fig. 3), and in places may resemble the growth-lines of a shell, but this appearance is purely accidental. In the notes which he has kindly lent me, Mr. Lewis Abbott calls attention to the fact that these curves are ovals, or sections of ovals, all of which lay in a horizontal plane when the specimens were *in situ*. They correspond to differences in the coarseness of the original material. In all the bodies there is a very pronounced transverse cleavage, usually at right angles to the axis of the spiral, although in one specimen it makes an angle of about 70° with the axis. There is also some tendency to cleave along the sutures between the whorls, but this is much less marked, fracture-surfaces usually cutting right across the sutures. Since the bodies lay horizontally, their cleavage can have no relation to the bedding-planes of the strata.

The question naturally arises as to the character of the cavities in which these bodies lay. How much space was there between each body and the surrounding rock? Were there any definite impressions on the external mould such as might correspond to the ornamentation and growth-lines of a gastropod shell? For such information as it is possible to publish on this

subject (unfortunately no specimens showing the external mould have been preserved) I am indebted to Mr. Lewis Abbott. Owing to the extensive chemical changes which have taken place in the matrix since its original deposition (see below), it is not surprising that no very clear markings were preserved on the moulds, but, whereas most of them could have been formed as moulds of smooth shells (sometimes carinated), others seemed to indicate a tuberculate ornamentation.

Having now noted the chief features of these remarkable bodies, we may proceed to a discussion of their possible nature. Are they, as their appearance suggests, casts of gigantic shells, or is their formation to be attributed to some other agency, organic or inorganic? Mr. Lewis Abbott, whose knowledge of the petrology of the Wealden rocks is unrivalled, is emphatic that the former theory is the only possible one. Mr. Woodward also, after consideration of a number of theories, has come to the conclusion that, on account of the remarkable regularity of their coiling, they cannot be anything else than casts of shells, and accordingly has definitely placed them on record as constituting a new genus and species of gastropod mollusc, named by him *Dinocochlea ingens* (*Geological Magazine*, 1922, vol. lix, pp. 242-247).

The most obvious objection to this view is the enormous size of these bodies in comparison with that of all previously known gastropods, especially freshwater ones. The largest fossil gastropod known is the marine *Campanile* of the Eocene, a fine specimen of which, about 20 inches in length, is exhibited a few yards from *Dinocochlea*; in comparison with the latter it is a mere dwarf. The largest marine gastropods living at the present day are about 24 inches in length, but among freshwater shells we have nothing bigger than certain representatives of the *Pilidæ* and *Thiaridæ*, which are about 6 inches in length. However, other molluscan groups have at times produced gigantic representatives comparable to *Dinocochlea* in size. Among the *Cephalopoda* we have *Actinoceras* of the Carboniferous, the length of which may have been as much as 8 feet, and a number of gigantic ammonite species, a cast of the largest of which, an Upper Cretaceous *Pachydiscus*, 6 ft. 8 in. in diameter, is exhibited at the end of Gallery 7 of the Geological Department.

Freshwater snails are thin-shelled in comparison with most of those that live in the sea, but it is inconceivable that a monster 7 feet in length should not have had a shell fairly thick (possibly $\frac{1}{2}$ inch) near its aperture, in order to withstand the mechanical forces to which it must have been subjected during

the normal life of the animal. Since, as now preserved, the spiral is quite solid, with no spaces corresponding to the walls of the whorls and the columella, it is obvious that, if it consists of the infilling matrix of a shell which disappeared by solution, it must have shrunk so as to fill up all the space vacated by the shell. Casts of shells in which the intervals have been so obliterated do, it is true, occur commonly in soft sandstone matrices, which have remained sufficiently plastic. Usually, however, in such cases the pressure of the superincumbent beds has resulted in a flattening or distortion of the spiral form of the cast, neither the external mould nor the cast being rigid enough to resist pressure. It is certain that *Dinocochlea* shows no sign of having been distorted by vertical pressure, although there are some irregularities in the coiling of the later whorls, which might be explained by this "shrinking" theory.

The stratum in which *Dinocochlea* was found seems, however, to have undergone more vicissitudes than a soft sandstone of the nature just discussed. Deposited originally as a sand varying in coarseness, it was subsequently subjected to a process involving local segregation of lime, whole bedded masses, as well as large, botryoidal concretions, of the hard bluestone being formed. Subsequently, percolating underground waters attacked the bluestone, removing the calcium carbonate in solution, and producing the sandstone which now remains, with cores of unaltered bluestone. Although any shells present in the original sediment probably disappeared by solution in that portion which escaped conversion to bluestone, in the bluestone itself shells are still to be found in an unaltered condition; their calcium carbonate may have recrystallized as calcite. Hence presumably it could not have been until after the initiation of the final process of decalcification, which, it must be remembered, was a very gradual one, that the shell of *Dinocochlea* could have dissolved away. Since the core remained bluestone until the very last, it seems inconceivable that the whole spiral could have shrunk so as to fill up all the space left by a thick shell, although in small shells the intervals may have been obliterated. It may be noted in passing that Mr. W. Campbell Smith has calculated that no appreciable change in volume would accompany the process of decalcification. Moreover, the process of decalcification has not yet affected the very core of a few of the largest whorls, but instead of finding here, as we should expect, traces of the actual calcareous columella of the shell, we find nothing but the normal bluestone. It also results from what has been said concerning the persistence of all shelly matter until after the bluestone stage, that there can be no question of the spiral bodies having been

formed by the infiltration of plastic matter into rigid moulds left by the solution of large shells.

As further objections to the "shell" theory may be mentioned the unusual size of the apex in proportion to that of the whorls, the differences in the measurements of the early whorls of the two specimens—unusually large for two associated individuals of one species—and the presence of dextrally and sinistrally coiled individuals in about equal numbers, a proportion only found very rarely in species of the gastropoda. Finally, there is the strange termination of the spiral, already described, and the entire absence of any cast of an aperture; a feature which could only be explained away by supposing that the last whorl of the spiral has become enveloped in concretionary matter and the apertural region obscured. But where does the true spiral end and the concretionary matter start?

If, however, these huge spiral bodies are not to be regarded as casts of shells, what else could they be? We may search in vain for any previous records of comparable objects. It is true that gigantic spiral bodies termed *Dæmonelix*, or "Devil's Corkscrews," occur in a sandstone of Tertiary age in Nebraska (Figs. 5 and 6). They differ from *Dinocochlea* in two very important features: first, they are open coils more or less constant in diameter, and not tapering to an apex; secondly, they occur in a vertical instead of a horizontal position in the strata. They are now believed to be infillings of cavities left by the decayed roots of desert plants, although by some they have been regarded as infillings of borings of rodents. Obviously, neither of these explanations can apply to *Dinocochlea*. The suggestion that *Dinocochlea* may be the cast of a gigantic coprolite is too absurd for consideration. No hypothesis invoking the action of swirling subterranean waters in producing spiral cavities in the strata will bear examination. In fact, if we are still inclined to reject the "shell" theory, it seems that the only alternative is to postulate a concretionary origin for *Dinocochlea*.

A common occurrence in strata of all ages, concretions are essentially nodular growths of mineral matter, frequently formed round some organic body as nucleus. The physico-chemical processes connected with their formation are by no means fully understood, but dredgings tell us that they are being formed on the ocean floor at the present day and that their formation may start soon after the deposition of the strata in which they are found. Most frequently they are lenticular, spheroidal or botryoidal in form, but at times they may have all manner of peculiar shapes, even simulating organic objects, such as bones. Now, as has already been mentioned, huge botryoidal



Photograph by

W. J. Lewis Abbott.

FIG. 4.—BOTRYOIDAL CONCRETIONS ASSOCIATED WITH *Dinocochlea*.
(The coin shows the scale.)



FIG. 5.—*Dæmonelix in situ* (after Barbour).

masses (Fig. 4), which without doubt are true concretions, occur associated with the giant spirals in the same bed, and comparison with the spirals discloses many points of resemblance in their general lithological structure. Cross-sections show a similar concentric arrangement of lighter and darker matter, with the bluestone forming the core.

Obviously, however, these concretions have been greatly altered chemically, since their original formation, by a process similar to that which has affected the spirals, and these points of resemblance may be of secondary origin. In one important character, their cleavage, the concretions and the spirals differ greatly, since the former, as would be expected from their mode of growth, show a pronounced tendency to exfoliate (*i.e.* their layers tend to peel off, like those of an onion). In the spiral bodies there is no such tendency, but, on the other hand, there is the pronounced transverse cleavage already mentioned, almost suggesting that the spirals had been built up in layers perpendicular to the axis and hence orientated vertically when *in situ*. But it is not easy to offer any explanation of this structure on the shell theory either, especially when it is remembered, as Mr. Lewis Abbott points out, that the oval markings on the surface of the spirals, originally lying in horizontal planes, seem to correspond to the gradual infilling of the interior of a shell by horizontal layers of sand varying in coarseness, and we should expect a corresponding cleavage to have developed. When discussing the question of the decalcification of the bluestone and the disappearance of the shell of *Dinocochlea*, it has been rather assumed in a foregoing paragraph that the matrix surrounding the spiral bodies consisted, like the bodies themselves, of decalcified bluestone; but, if it actually consisted of sandstone which had not passed through the bluestone stage, the analogy between the bodies and the botryoidal concretions would be heightened. On this point it is, unfortunately, impossible to make any definite statement.

Whatever be the significance of the differences between the spiral bodies and the associated botryoidal concretions, one thing is certain—it is impossible to explain the initiation of the building up of regularly increasing spirals of this nature by any purely inorganic process. If concretions, they must have grown round some originally spiral nuclei, long since decayed away. What these nuclei may have been, whether animal or vegetable, it is impossible to suggest.

In the above account I have attempted to present in an unbiased way the arguments which can be advanced for and against the view that these strange spiral bodies are the casts of

huge shells. There may be numerous objections to the "shell" theory, but it can at least be said that no plausible case can be made out for any other explanation yet suggested, and to dismiss the bodies as ordinary concretions is absurd. Yet even if, like Mr. Woodward, we are driven to the "inevitable conclusion" that these bodies are the casts of shells, we somehow retain a lingering suspicion that this inevitable conclusion is not the correct one. The whole matter is one of nature's biggest riddles, and as such we must be content to leave it for the present. Some day, perhaps, another section will be opened in the beds in which these bodies were found, and additional data will be obtained which will give some clue as to their nature. If there still remain "more things in heaven and earth than are dreamt of in our philosophy," *Dinocochlea* appears to be one of them.

In conclusion, it must be mentioned that it has been through the kindness of Mr. W. J. Lewis Abbott and of the Committee of the Hastings Corporation Museum that the original fragments of the large restored specimen, together with numerous other fragments, have been presented to the Natural History Museum. To Mr. Lewis Abbott I am further indebted for the loan of some interesting notes which he made on the occurrence of the specimens at the time of their discovery, as well as of some photographs, one of which illustrates the present article.

APPENDIX.

By a coincidence, information has recently reached the Geological Department of an extraordinary body dredged in the North Sea by Mr. Ferdinand Anderheggen, of Brussels. The actual site was on the north-west of the West Hinder Bank, in latitude $51^{\circ} 30' N.$, longitude $2^{\circ} 25' E.$ This remarkable body, formed of a hard sandstone, is 4 ft. 2 in. in length and about 3 ft. in diameter, and, as may be seen from the accompanying illustrations (Figs. 7 and 8), is irregularly spiral in form. Reminiscent as this body is of *Dinocochlea*, it is very difficult to account for its presence loose on the sea-floor in the locality where it was found. It is probable that Tertiary, rather than Wealden, rocks form the sea-floor here, and in any case one would expect them to be covered by sediment if not, like the Dogger Bank, by Neolithic terrestrial deposits. That this body could be a recently formed concretion is out of the question. Was it brought from the north by floating ice, or from some unknown locality by human agency? Such questions are as difficult to answer as those relating to the nature of *Dinocochlea* itself.

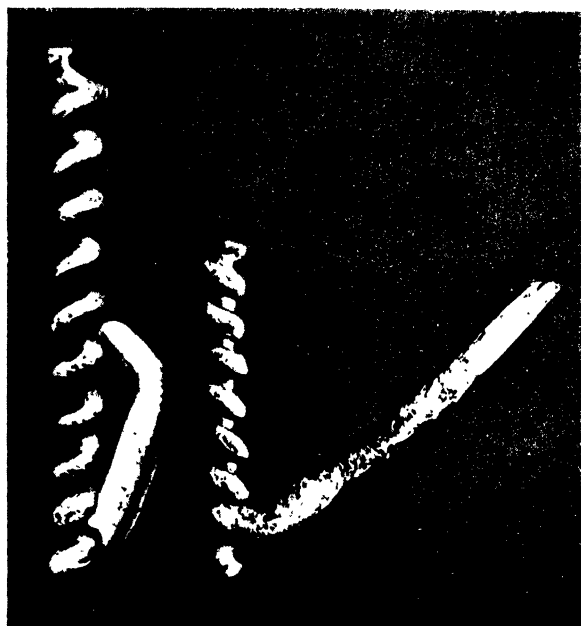


FIG. 6.—*Dæmonelix*
SPIRALS (after
Barbour).



FIGS. 7 AND 8.—SPIRAL BODY RECENTLY DREDGED IN THE NORTH SEA.

THE CONGO DERBY ELAND.

By J. G. DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

ONE of the most important additions to the exhibition galleries during recent years is a mounted specimen of the Congo race of Lord Derby's eland (*Taurotragus derbianus congolanus*), presented by Sir Charles Markham, Bart. This specimen, which has been most attractively mounted in the Rowland Ward Studios, is a fine adult bull, with good horns, shot near Fort Archambault, Shari River District, French Equatorial Africa.

The Derby eland is frequently referred to as the "giant eland," but this is rather a misnomer, since the common eland is frequently larger in size, standing higher at the shoulder; *Taurotragus derbianus* measures about 5 ft. to 5 ft. 8 in. in height, whereas old bulls of *Taurotragus oryx*, the common eland, may perhaps measure as much as 6 feet at the shoulder. The horns, however, are larger and more massive than those of the latter species.

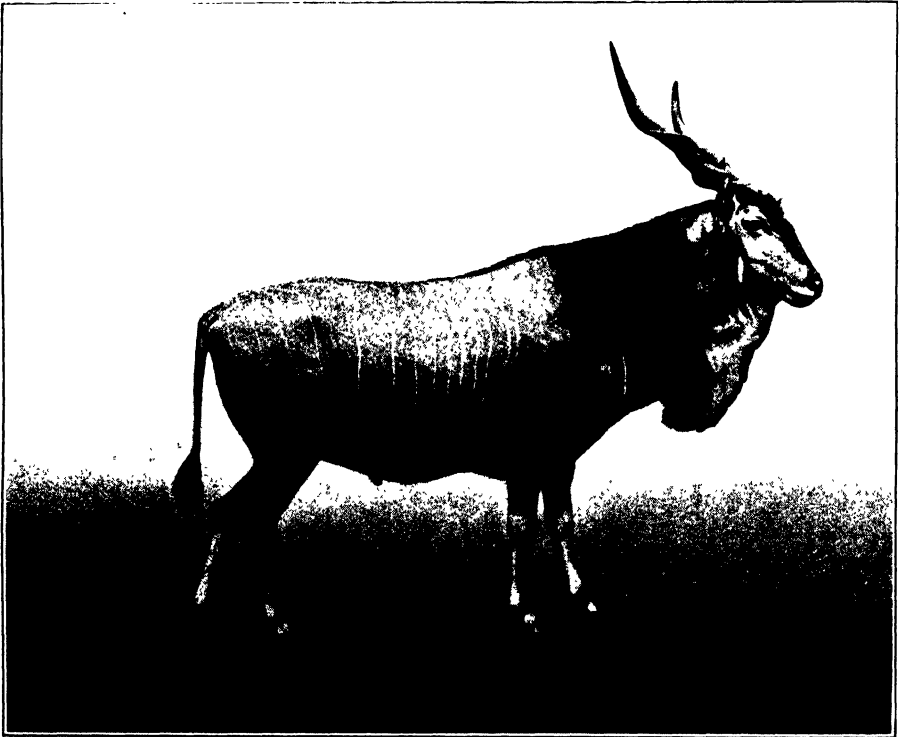
Lord Derby's eland was first described by the late Dr. J. E. Gray, Keeper of the Department of Zoology from 1840 to 1874, on the evidence of a pair of horns sent home from Senegambia by a collector employed by the thirteenth Earl of Derby to make collections for the Knowsley menagerie. The species is at once distinguished from the more southern form, *T. oryx*, by the larger and heavier horns, much broader ears, and more richly coloured body and head. Three races of the Derby eland are now recognized, the typical race (*T. derbianus derbianus*) from West Africa, a Congo race (*T. d. congolanus*) from Central Africa, and the Sudani race (*T. d. gigas*). The horn measurements of the typical Derby eland are rather less than those of the Sudani race, the former rarely exceeding 36 inches in length, whereas good horns of the latter are from 39 to 40 inches in length. The Congo race has, as a rule, very large horns, measuring from 41 to 44½ inches; Sir Charles Markham's specimen carries horns of 41 inches in length, with a tip to tip interval of 31 inches. The record head, owned by Lord Rothschild, has horns of 44½ inches with a tip to tip interval of 26 inches. These measurements considerably exceed the corresponding dimensions of the male horns of *T. oryx*, the typical form of which rarely carries horns of greater length than 37 inches; sometimes females of the South African races have considerably longer, but more slender, horns than the males, the records for female horns

being 38 inches and $39\frac{1}{2}$ inches. The East African race of *T. oryx* (*T. o. pattersonianus*) carries still smaller horns, the best horn measurements for this race being only about $32\frac{1}{4}$ inches.

The ears of the Derby eland are more like those of a bongo in shape, being very much broader than the narrow ears of the common eland. The general colour of the animal is considerably richer and the white body stripes more prominent; the latter are from 11 to 15 in number and show up vividly against the tawny background. Above the shoulders and on the sides of the neck there is developed a blackish mane, which extends, in front, a short distance on to the large dew-lap; posteriorly this black area is terminated abruptly on the chest by a white chevron-like marking. On the back the black colour is continued down the mid line as a median stripe, which extends as far as the base of the tail. The forehead of the subadult male, and adult female, is chestnut-red in colour; in the old bulls a chocolate-tinted tuft of longish hair is developed on the frontal region. The nose is black, and a white stripe extends from the eyes to the black of the nose, thus forming a border to the reddish frontal marking. Further, there is a white vertical stripe below each eye, and the backs of the ears are black, very unlike the pale-coloured ears of *T. oryx*. On the hinder part of the fore-legs there are black, garter-like markings, and similar black patches are situated just above the white hoofbands. It should be noted that most of these dark markings tend to fade with age. In the common eland the general colour is considerably paler, and the stripes less numerous and less conspicuous; the mane-like area is never more than brown in colour. The face markings are less obvious, and the white chest chevron is absent. Further, the dew-lap commences on the middle of the neck and extends to the chest, whereas in *T. derbianus* it commences at the chin and terminates about half-way down the neck. The Derby eland, then, differs very markedly from the South and East African species, *T. oryx*, the most striking differences between the two forms being the size of the horns, the shape of the ears, and the colour of the body. The three races of Lord Derby's eland are all very similar; the Sudani race (*T. d. gigas*) differs from the typical race in being paler in colour, having fewer body stripes, and larger horns; this eland appears to be confined to the Bahr-el-Ghazal and the Lado Enclave in the Sudan. The type locality of *T. derbianus derbianus* is Casamance, south of the Gambia; this western race has also been recorded from the Cameroons and Portuguese and French Guinea. Further east, in French

Equatorial Africa and the Northern Congo, the typical *derbianus* grades into the Congo form (*T. d. congolanus*), which possesses longer horns, but is equally richly coloured.

The elands, in spite of their great size and ox-like build, are really true antelopes, being members of the subfamily *Tragelaphinae*, which, in addition to the elands, includes the typical bushbucks, kudus, bongo, the Indian nilgai, and the four-horned antelope. The members of this group are large, medium, or small-sized antelopes with horns (except in the bongo and



CONGO DERBY ELAND.
Height at shoulder, 5 ft. 0 $\frac{1}{2}$ in.

eland) present only in the male sex. The bushbucks, which include some of the most handsomely coloured of all game animals, are very widely distributed over the greater part of Africa south of the Sahara; they are usually bright chestnut in colour, with whitespots and stripes on their flanks, hence the name of "harnessed-antelopes." Closely allied to the bushbucks are the animals known as the nyala (*Tragelaphus angasi*), the mountain bushbuck (*T. buxtoni*), and the situtunga (*Limnotragus*

spekei). The nyala is rather like a large bushbuck with beautifully shaped horns; the male is slaty-grey in colour and the female bright chestnut with the white, harness-like markings of a bushbuck; it is confined to a comparatively small area in South-East Africa. The mountain bushbuck is distinguishable from all the other members of the genus by its much bigger and more massive horns and larger size, standing nearly as high as a kudu at the shoulders; this species has, at present, been recorded only from the Sahatu Mountains in Gallaland. The situtungas, which about equal in size the nyala, are easily distinguished by their elongated hoofs; by means of these long hoofs the animals are enabled to walk upon the soft mud of the swamps in which they live. The various forms of situtunga spread from West Africa eastward to Uganda and south as far as Northern Rhodesia. The kudus, represented by two distinct species, if not genera, are easily known by their spirally twisted horns; the greater kudu (*Strepsiceros strepsiceros*) is a very large beast with magnificent horns; the record horn length being $71\frac{1}{2}$ inches along the outside curve, and $51\frac{1}{4}$ inches in a straight line. These animals enjoy a very wide distribution, being found over the greater part of Africa south of the Sahara and north of the Zambesi; to the south of that river, southwards to Cape Colony, the kudu was formerly a common beast, but it is now rare in many of its former haunts. The other kudu is the lesser species (*S. imberbis*), which is much smaller in size (only about 40 inches at the shoulder instead of nearly 60 inches) and carrying very much smaller horns, the best specimens on record measuring only about 36 inches in length; this antelope is confined to the northern part of Tanganyika Territory, Kenya Colony, and Abyssinia. The bongo, of which three forms have been described, is one of the most strikingly coloured of all antelopes, being a rich rufous-red in colour and having the body marked by a series of white, vertical stripes, ten to thirteen in number, and possessing exceptionally massive horns; it is widely distributed over a great part of Equatorial Africa, living exclusively in dense forest country; it extends south as far as Katanga, in the Southern Congo. The nilgai, or blue bull (*Boselaphus tragocamelus*) is easily distinguished from the other members of the subfamily by its ungainly build, bluish-grey coloured coat and short horns; this animal is found only in peninsular India. The other Indian representative of the group is the four-horned antelope (*Tetraceros quadricornis*), the males of which are readily recognized by the possession of four horns, and are thus quite distinct from all their relations.

The common eland (*T. oryx*) has been divided into a number of geographical races, but with one exception (*T. o. patterssonianus*) they do not appear to be of much importance; it is probable that all the elands that are, or were, found in the country to the south of the Zambesi may be referred, at the most, to two races. Such characters as the presence, or absence, of the bush on the forehead, and the distinctness of the body markings depend entirely on the age of the individual. Very old bulls have a large chocolate, or burnt-sienna patch of long hair upon the forehead; they also have the white stripes on the flanks very indistinctly marked, due to the scantiness of the hair in these old individuals. On the other hand, a young bull has no frontal tuft developed, but simply a chestnut marking on the forehead; the body stripes are more distinct in the young and subadult animals, owing to the hair being thicker and the slate colour of the skin not showing through. In this connexion it is interesting to see what Selous wrote in 1881:—"Old Eland bulls have very little hair on their skin, and look a dark slaty-blue colour, owing to the colour of the skin showing through the scanty hair, and on these old animals, naturally enough, no sign of stripes can be perceived. Old cows also turn to a slate colour from the same cause. In every large herd of Elands, cows are to be seen of every shade of colour, from pale fawn to bluish-grey. Therefore, your old hunter, who knows of four species of Lions, and six or seven Rhinoceroses, says that there are two or three distinct species of Eland, the blue, the yellow, and the striped. . . ." This last sentence, coming from such a capable and shrewd observer as Selous, tends to show that the great hunter was, occasionally, inclined to be sarcastic.

A SAILFISH NEW TO THE BRITISH FAUNA.

By J. R. NORMAN, Assistant Keeper, Department of Zoology.

ABOUT 9 a.m. (flood tide) on the 17th August last a large Sailfish, more than seven feet in length, was captured in a dying condition in the main channel of the Yealm estuary, South Devon, about a mile above the Yealm Bar. It was promptly secured by the Marine Biological Association, Plymouth, and presented by them to the Museum. The plaster cast shown in the accompanying illustration was prepared by

Mr. S. Stammwitz, and will shortly be exhibited in the Fish Gallery. Owing to the difficulty of preserving these large fishes in museums, except as stuffed skins, and also to the marked changes which they exhibit at different stages of growth, our knowledge of the group which includes the Swordfishes, Spearfishes and Sailfishes is limited, and the acquisition of such a fine specimen in a fresh condition is a matter for congratulation.

These fishes belong to the suborder Scombroidea, a group which also includes the Mackerels, Tunnies, Albacores, Bonitos and their relatives. The Sailfishes may be distinguished from their nearest allies the Spearfishes by the long, high dorsal fin which gives them their name. The Swordfishes have a long,

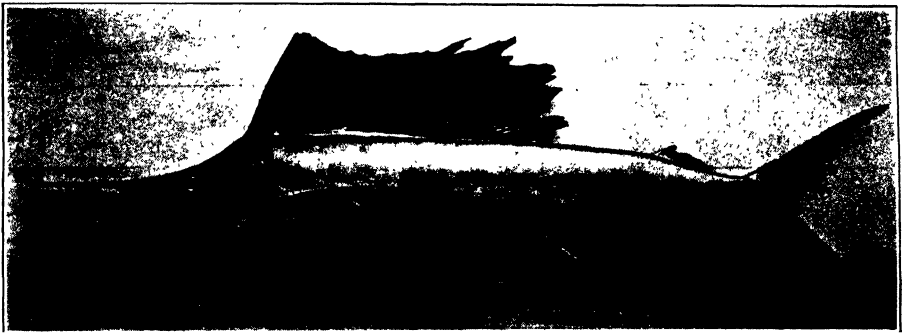


FIG. 1.—PLASTER CAST OF SAILFISH (*Istiophorus americanus*) FROM SOUTH DEVON.
Length 7 feet.

flat, blade-like sword instead of a rounded spear, and have no pelvic fins—the fins that correspond to the hind limbs of land vertebrates. Sailfishes are found in all warm seas, and on calm days may be seen basking at the surface of the water with the dorsal fin projecting: they then form a striking sight, as this fin is often coloured brilliant blue with a number of round black or brown spots. They are among the swiftest fishes known, every line of their contour being suggestive of rapid motion. The long-drawn-out snout provides an efficient cut-water, the slender body is covered with small scales, more or less hidden in the skin, and the slim tail, strengthened on either side with a pair of fleshy keels, bears a powerful, deeply-forked tail fin, which provides the principal means of propulsion through the water. When a Sailfish is under way and moving at high speed the dorsal fin is depressed into a deep groove in the back,

and the long pelvic fins are similarly stowed away in a groove in the belly, so that they shall offer no resistance to the water.

The species caught in Devonshire, the American Sailfish (*Istiophorus americanus*, Cuv. and Val.), is comparatively common on the western side of the Atlantic, ranging on the American coast from Brazil northwards to Cape Cod and beyond. It probably occurs also in other seas, but seems to be extremely rare on this side of the Atlantic, there being only one authentic record of its occurrence there: this was a large specimen taken off the west coast of Africa. A small Sailfish caught between

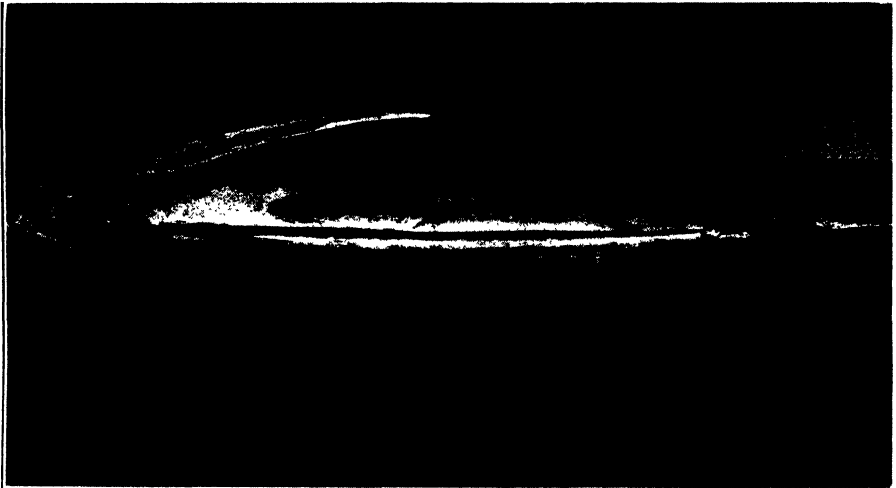


FIG. 2.—VENTRAL VIEW OF SAILFISH (*Istiophorus americanus*), SHOWING GROOVE FOR RECEPTION OF PELVIC FINS.

the Cape of Good Hope and France, and described as a distinct species, may eventually prove to be the young of the American Sailfish.

Sailfishes, as well as Swordfishes and Spearfishes, are great favourites with sea anglers in America, both on the Florida coast and at Santa Catalina in California. Some of the species reach a length of twelve to fifteen feet, and fishing for them with hook and line provides exciting and sometimes even dangerous sport: when hooked or speared, they may make desperate leaps out of the water, and perhaps fall on the boat, or in their frantic rushes may charge the boat and spear it.

EXHIBITS ILLUSTRATING BRITISH FUNGI.

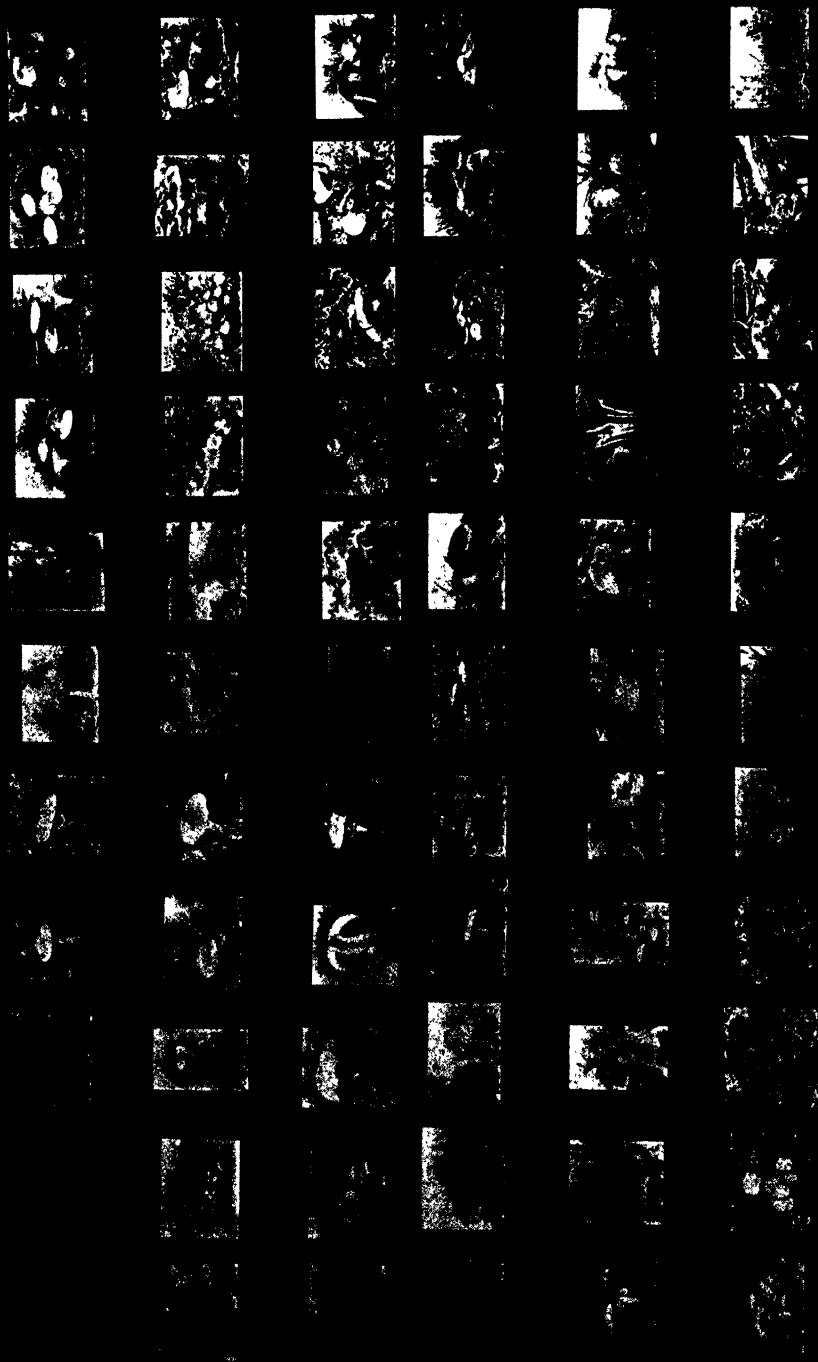
By J. RAMSBOTTOM, O.B.E., M.A., Deputy Keeper, Department of Botany.

THERE has recently been added to the exhibit of British Fungi a couple of table-cases showing sixty-six transparencies of larger fungi in their natural habitats. The transparencies are in the form of lantern-slides and were hand-coloured by Colonel C. Theodore Green, A.M.S., of Birkenhead, who is well known for the beauty and delicacy of his work. It is hoped to duplicate the slides and to use the second set for loan with accompanying lecture notes.

The slides form an attractive addition to the illustrations of the British Fungus-Flora already in the gallery. A list of these may be of interest.

1. **Sowerby models.** This collection of models was in the possession of James Sowerby, the famous naturalist-artist. They are said to have been made by him during the course of the publication of his "Coloured Figures of English Fungi or Mushrooms" (1795-1815), the original drawings of which are in the Department. According to the "History of the Collections," the models purchased from the son, James de Carle Sowerby, in 1844 numbered 168. It is probable that they were added to after that date, for there are German labels on the stands of a few of the 208 models now shown; moreover, the majority of the models are of fragile unbaked pipe-clay, whereas the remainder are of some other material. The models were exhibited in Sowerby's house, "No. 2, Mead Place, near the Asylum," Lambeth, on two days a month, and the public was admitted free. His object was to spread a knowledge of the identity of poisonous fungi so as to prevent the fatal mistakes which were apparently not then uncommon. It is worth remarking that at that time several different toadstools were sold in Covent Garden Market, and that fungus-poisoning in this country practically ceased with the restriction of the sale to the common mushroom (*Psalliota campestris*), the only fungus now sold in England, though there do not appear to be any regulations on the matter.

The models suffered from their fragility and the colours changed through the action of light and dust. When they were to be placed in their present position they were repaired by a formatore from the British Museum (Bloomsbury), and Worthington G. Smith recoloured and remounted them.



EXHIBITS ILLUSTRATING BRITISH FUNGI.

The upper three rows and the lower three rows are on opposite sides of the table-case.

2. Series of Water-colour Drawings of the Larger Fungi.

These are arranged on three stands. The drawings were made by Worthington G. Smith and were begun in 1891. They are original to the extent that they are chiefly based on Smith's original drawings, which are in the Department, as are also those of Phillips, Wheeler, Massee, Mrs. Russell, and others. The Basidiomycetes occupy 104 sheets, and there are also three sheets of the larger Discomycetes and one of the Tuberaceæ. (In addition to these drawings the remainder of the British Fungi are also exhibited. These, which occupy 132 sheets, were begun by the late George Massee, but were chiefly the work of Miss Lorrain Smith. There is a drawing of each genus and descriptions, with specimens, of the species.)

3. Two subsidiary exhibits of Basidiomycetes. These also are the work of W. G. Smith, the one showing Field and Cultivated Mushrooms and their Varieties and Poisonous or Worthless Fungi often mistaken for Mushrooms, which was published with text in 1909, the other of two sheets, of Poisonous and Edible species respectively.

The chief merit of the new series is that it shows the fungi in their natural surroundings. The labels which are in preparation give some of the more important points of interest about the various species as, *e.g.*, that *Amanita phalloides* is the most poisonous species known, that oak wood made green by the mycelium of the Discomycete *Chlorosplenium æruginosum* is used in Tunbridge ware, that *Tricholoma personatum* was formerly sold in Covent Garden as "blewits," and so on. It is, however, the advantage of natural habitat photographs of this kind that they somehow give the impression of the reality of the fact that these organisms may be found on a country walk, which is difficult for some people to grasp from ordinary drawings. In addition, much information can be gained from their perusal. It is at once apparent that some species are pasture species and also that some genera are almost wholly so, as, for example, *Hygrophorus* with its frequently brilliantly coloured species, of which *H. pratensis*, *H. coccineus*, *H. conicus*, and *H. calyptreiformis* are shown. Many if not all of these pasture-living species grow in rings, the best known being the Fairy Ring Champignon, *Marasmius oreades*, which by the compacting of its mycelium and the consequent impermeability of the soil shows clearly the bare portions, proof positive to those who believe in them that fairies wore away the grass in their midnight frolics. Other species are shown growing on tree-stumps or on dead or living trunks. *Polyporus squamosus* photographed on a dead

trunk is quite commonly to be seen also on living trees in London parks. These fungi may be parasitic, usually gaining a foothold through a wound, or may be saprophytic, not appearing until the tree is dead.

The surrounding vegetation, moreover, often gives a clue to other points of biological interest. Most of the slides show the fungus in characteristic habitats, and it is therefore obvious whether a terrestrial fungus is an inhabitant of pasture or woodland, and further, if the latter, whether the trees are deciduous or coniferous. The fungi of woods are just as characteristic and usually more frequent than their flowering plants. Of the species shown, *Lactarius rufus* and *Gomphidius roseus* are examples of pine-wood species, *Amanita phalloides* and *Cantharellus cibarius* of species usually found in deciduous woods.

It is apparently not merely that certain fungi occur in one type of wood rather than in another, but that some species are found closely associated with definite trees. Most people soon become aware of the association say between *Amanita muscaria* and the birch. The mycelium of the fungus growing in the soil year after year frequently forms a sort of sheath round the rootlet of the tree. Most forest-trees possess such fungus-roots (*mycorrhiza*), the tree apparently benefiting by being able to make use of the nutrient activities of the fungal mycelium. Several different species of fungi may enter into union with the same species of tree. A field-mycologist who realizes the part fungi must play in nature on account of the necessity of their obtaining organic food already elaborated constantly encounters problems which add to the interest of the study of mycology. This delightful series of slides will doubtless serve to draw the attention of many of those who visit the gallery to the real beauty of these fascinating denizens of our countryside.

A YOUNG SLOTH-BEAR.

By J. G. DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

AMONG the mounted specimens recently presented by the Rowland Ward Trustees is a young Sloth-bear, or Aswal (*Melursus ursinus*); the specimen is quite a baby, the total length of the body hardly exceeding eighteen inches. A fully-grown sloth-bear will measure nearly six feet in length (over all) and weigh about 280 to 300 pounds, and, when very fat, is rather heavier; one record exists of a 320-pound bear.

The sloth-bear is now considered to be quite distinct from all the other members of the family *Ursidæ*, and for this reason is placed in a separate genus, *Melursus*; it differs from the typical members of the group in having only two pairs of incisor teeth instead of three pairs; the cheek-teeth are smaller and the palate larger. Externally it may be known by its long and untidy coat, large and powerful claws, mobile snout, and very long, extensile tongue. The claws are large and whitish in colour,



YOUNG SLOTH-BEAR.

otherwise, with the exception of the grey-tinted snout and white horseshoe-like marking on the chest, the animal is entirely black. In general bodily size this bear is rather smaller than the black Himalayan species, the head and body measurement being about four and a half to five and three-quarter feet, whereas the Himalayan bear will sometimes measure as much as six feet five inches, but usually does not exceed five and a half feet in length. The tail of the sloth-bear is rather long, measuring about four

or five inches, that of the black bear being rarely more than three inches in length. A sloth-bear stands about three feet high at the shoulder. The ears are large and the structure of the snout seems to suggest that the animal can close its nostrils at will, by compression from above downwards; this probably assists the beast when burrowing for insects.

This bear is restricted in its distribution to peninsular India and Ceylon, ranging from the base of the Himalayas to Cape Comorin; westward it extends to Kutch and Kathiawar and it is known from Eastern and Northern Bengal.

The sloth-bears do not hibernate, and are, in spite of their heavy coats, quite at home in even the hottest locality. The claws are very formidable weapons, being about four inches in length; they are chiefly used for digging up ants and other insects, or turning over stones while searching for their prey. When suddenly surprised the bears are liable to attack man with surprising ferocity, and inflict terrible wounds with their long claws. A female bear with her young ones is more likely to attack than a solitary individual; an animal at bay is at all times dangerous. Normally they may be regarded as timid and inoffensive beasts. Their eyesight and hearing are very deficient, and when busy searching for food they may be approached, if the wind is favourable, within a few yards. Their power of scent is, however, very keen, and by this means they discover insects buried deep in the ground and honey high up in the trees; they can detect the presence of a man at a very considerable distance, if the wind is in their favour. Their food consists chiefly of ants and the larvæ of certain large beetles; they are also fond of a variety of fruits, and in Southern India are partial to the seed-pods of a common jungle shrub, *Cassia fistula*; these pods are reported to contain a juice of a highly laxative nature. In some localities these bears have a bad name for raiding the groves of wild date-trees, from which the fermented sap, or *henda*, is obtained; it is reported that they climb the trees, tip up the pots placed to collect the juice, and drink the contents. The natives do not appear to mind the bears stealing the drink so much as the number of pots that get broken through these depredations; it is asserted that the bears, after their liberal potations, frequently get intoxicated, and are either unable, or too lazy, to climb down the trees properly, but simply drop down backwards on to the ground. Sometimes the sloth-bear develops a liking for a carnivorous diet, there being a case on record of a bear, or bears, which devoured the body of a dead muntjac.

These bears associate in pairs, the male and female frequently living together, except when the female has cubs. When three bears are found together they are usually a mother and two cubs. The female has two or three young ones at a birth, and will carry them on her back during her daily round; the young ones are carried in this way until they are several months old. Sometimes this practice is continued for so long a time that there is only room for one young one at a time; when danger threatens the baby bears scramble quickly up on to their mother's back and are thus carried even through the thickest undergrowth.

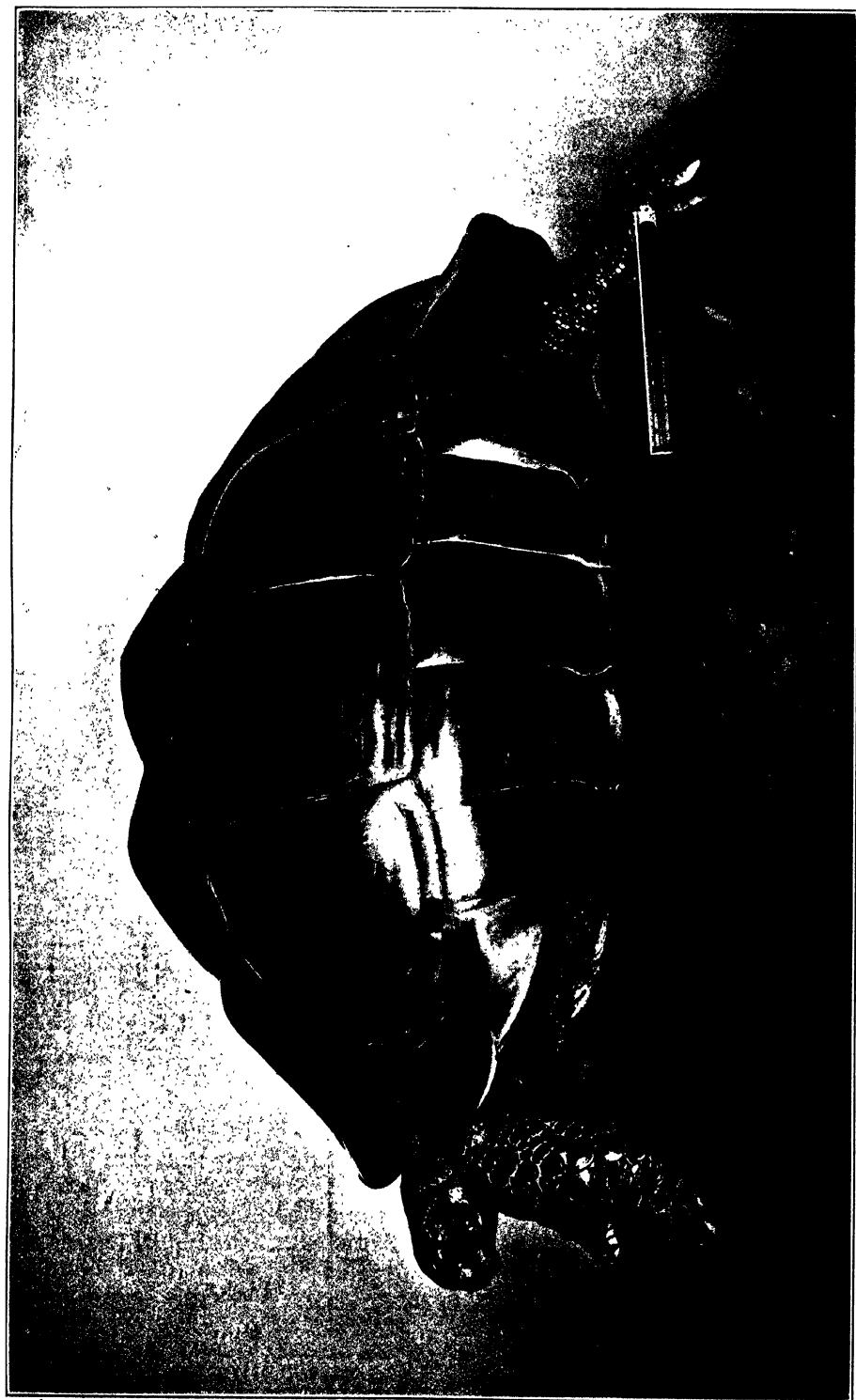
The footprint of a sloth-bear is rather like that of a human being, and it is by no means rare for a novice to mistake the one for the other. These bears are hunted in two or three ways; perhaps the most sporting way is to pursue them armed only with a knife and assisted by a pack of mongrel dogs. This was the method employed by G. P. Sanderson, the author of "Thirteen Years among the Wild Beasts of India." Another method is to have them driven by beaters on to the guns, or to wait at their rock-bound homes and shoot them as they return in the early hours of the morning. Sloth-bears do not advance to the attack upon their hind-legs, but come on all-fours, even when at close quarters, and they are not known to indulge in the traditional hug.

A GIGANTIC LAND TORTOISE FROM THE SEYCHELLES.

By H. W. PARKER, B.A., Assistant Keeper, Department of Zoology.

THE tortoise shown in the accompanying photograph has recently been acquired by the Museum and is probably the largest Seychelles tortoise ever recorded. It is a male specimen with a shell measuring $49\frac{1}{2}$ inches in straight length by 65 inches over the curve, and thus slightly exceeds the previous largest example in the Museum, the magnificent male *Testudo elephantina* which is exhibited in the Reptile Gallery. The largest recent land tortoise is a $52\frac{1}{4}$ -inch *Testudo daudini* which is believed to have originated in Aldabra, and is now in the possession of Lord Rothschild.

In the past these large tortoises have been supposed to be of great age, but in recent years critical examination of some of the details on which the estimates of age were based has thrown grave doubts on their accuracy, and it is consequently



GIGANTIC LAND TORTOISE.

very interesting to find that the present huge specimen is said to be only about sixty-eight years old. Formerly the animal lived on the island of St. Anne, but it seems very doubtful whether it is a descendant of the original tortoises which once inhabited this island. That at one time there were indigenous tortoises there is beyond doubt, for Monsieur Malavois, who carried out an official inspection of the Seychelles during the years 1786 and 1787, writes (translation): "On Isle St. Anne there are some 200 Land Tortoises, but 2000 could well live there." During the early years of the nineteenth century, however, there was a regular trade in these animals as provision for ships, and some idea of the extent of the traffic may be obtained from the fact that in 1826, by which date they were becoming relatively scarce, 2400 specimens were shipped from the Seychelles to Mauritius alone. In fact, soon after 1830 many of the Seychelles islands were entirely denuded, and so many transportations had occurred backwards and forwards within the group as well as to Aldabra and the Mascarene Islands that it became quite impossible to form any idea as to which of the various races had originated in any one island. Many races were undoubtedly completely exterminated, and though at present four are recognized which were probably indigenous to the Seychelles, it is highly probable that all the tortoises which still survive there in a state of semi-domestication are hybrids of uncertain ancestry. The new specimen provides no exception to this general conclusion, and consequently any attempt to express its relationships to known forms can only be tentative; its very high, domed shell would seem to preclude relationship with the rather depressed *Testudo daudini* of Aldabra, and the indications of striæ on the shields of the carapace suggest that it may be a hybrid between the perfectly smooth *Testudo gigantea* and the very strongly striated *Testudo elephantina*, both of which are believed to have formed part of the original Seychelles fauna.

THE ALTAI SNOWCOCK.

By N. B. KINNEAR, Assistant Keeper, Department of Zoology.

IN September of this year a large consignment of Snowcocks, reported to have come from the Altai Mountains in Central Asia, was received in cold storage at Smithfield Market. Inasmuch as this particular species of Snowcock was represented in the collection by two or three skins only, the opportunity

was taken of securing further examples, not only to make into cabinet specimens, but also to be preserved in spirit for anatomical purposes.

The Snowcock belongs to the Game-bird family, and inhabits high altitudes in the mountain chains of Asia. One species, *Tetrogallus caucasicus*, is found in the Caucasus; a second, *T. caspius*, in the mountains of Asia Minor and Persia; a third, *T. tibetanus*, in Yarkand, Tibet, eastward to Szechuan and Kansu in Northern China; a fourth, *T. himalayensis*, in the Himalayas and the western Kuen-lun mountains; and a fifth, *T. altaicus*—the one obtained—inhabits the Altai and Sajan Mountains in the heart of Asia.

In colour the different species of Snowcock are, broadly speaking, varying shades of dark grey above, with buff markings and vermiculations, and the underparts white or grey, with buff or chestnut.

Little has been written of the habits of the Altai Snowcock, but those of the Himalayan and Tibetan species are well known.

In summer these fine game-birds haunt barren hill-sides, above the limit of forest growth up to 17,500 feet, while in winter they are found as low as 7000 feet, driven down by the snow.

The site selected for a nest is on a bare hill-side, under the lee of a crest or ridge, at the foot of a boulder or small bush. The nest itself is a slight hollow scratched in the ground, and lined with bits of grass and feathers.

The eggs are four or five, occasionally as many as seven, and range in colour from "café au lait" to reddish buff, with dark brown spots, chiefly at the pointed end.

The Snowcock is found in small coveys of six or seven, but at certain times and places in flocks of as many as thirty. If undisturbed they are very tame and easy to approach while feeding, but when enjoying a midday siesta in the sun a sentry is generally posted on a boulder or some other commanding position.

The crops of the birds received contained stalks of dry knotty grass, and they are also reported to feed on buds, roots, moss, fern and occasionally insects. In Tibet they come down to the barley stubbles in winter, and in the same country they have been observed flying down into the valleys to drink in streams just at sunrise. After quenching their thirst they work their way up the mountain-side again, feeding as they go.

Opinions differ as to their suitability for the table, but probably it depends to a great extent upon the food of the birds.

The Snowcock has three distinct notes, a subdued cackling noise, a low soft whistle and a call, which has been likened to that of a curlew.

RECENT IMPORTANT ACQUISITIONS.

Department of Zoology.

A fine specimen of the Congo race of Lord Derby's Eland (*v. pp. 28-32*), mounted in the Rowland Ward Studios; presented by Sir Charles Markham, Bart.

A valuable collection of trophies of game shot by the late Colonel G. P. Cosens in India and Africa; presented by Mrs. Cosens. The collection consists of sixty-five specimens, and includes some really good heads, among which may be noted two Gaur Bison (*Bibos gaurus*), an African Buffalo (*Synceros caffer*), a series of Grant's Gazelle (*Gazella granti robertsi*), and the antlers of two Thamin (*Rucervus eldi*).

A series of monkeys procured in west central Africa during the winter of 1927-28 by the donor, Major P. H. G. Powell-Cotton. The specimens include a Red Colobus Monkey (*Colobus bouvieri*), new to the collection, and a Short-tailed Guenon (*Allenopithecus nigroviridis*). The latter monkey was previously represented in the Museum collection only by the typical specimen, a young individual which was originally described as a member of the genus *Cerco-pithecus*. This series of specimens forms a very interesting addition to the collection of Primates.

A collection of birds and eggs from Africa, consisting of 1023 birds, 326 eggs, and 50 nests; presented by Rear-Admiral H. Lynes. This gift includes 964 examples of different kinds of small, fan-tailed Warblers of the genus *Cisticola*, which were collected by Admiral Lynes in Cape Colony, Portuguese West Africa, and various parts of East Africa. These small birds have a very intricate summer and winter plumage which it was impossible to work out without this additional material, and a special journey was made to obtain it. Over thirteen kinds new to science were discovered during the expedition.

A mounted specimen of a young Sloth-Bear (*v. pp. 38-41*); presented by the Rowland Ward Trustees.

A specimen of the King Cheetah (*v. pp. 1-6*) mounted in the Rowland Ward Studios; seven examples of the Altai Snow Cock (*v. pp. 43-44*); a Giant Tortoise from the Seychelles (*v. pp. 41-43*); purchased.

Department of Entomology.

A collection of about 10,000 insects of various orders from Argentina; collected and presented by Captain K. J. Hayward.

A large series of insects of various orders from South Africa; collected and presented by Mr. R. E. Turner.

A collection of 1072 South African water-bugs, including a number of type specimens; presented by Mr. G. E. Hutchinson.

A piece of honeycomb; presented by Miss S. N. Warner.

A queen wasp accompanied by a parasitic worm; presented by Mr. H. G. Fittness.

Department of Geology.

Casts of a large sea-urchin and jelly-fish from the Lower Carboniferous of Belgium; presented by the Director of the Royal Natural History Museum, Brussels.

The type-specimens of two new species of Coal-Measure lamellibranchs; presented by Dr. A. E. Trueman and Mr. J. H. Davis.

Rare Permian fossils from Sicily and other fossils; presented by Dr. C. T. Trechmann.

Eighteen fossil plants from the Cretaceous of Japan; presented by Prof. Yudzi Ogura.

Fifty specimens of brachiopods from the English Chalk; presented by Dr. M. R. Sahni.

A fine example of a fossil crab and other Gault fossils, from Folkestone; collected and presented by Dr. L. F. Spath.

A new species of crab from the Chalk of Purley, Surrey; presented by Mr. T. H. Withers.

Gault cephalopods from Osmington, Dorset; collected and presented by Lt.-Col. R. H. Cunnington, R.E.

A collection of over 400 specimens of London Clay fossils, collected bed by bed at Bognor, Sussex, by the donor, and specimens of the Chalk belemnite, *Belemnitella mucronata*, collected by the donor at Pagham, Sussex, and indicating a horizon in the Chalk higher than any yet known in that county; presented by Mr. E. M. Venables.

Mammal and bird remains collected by Miss D. A. Garrod from a Pleistocene deposit at Gibraltar; presented by the Trustees of the Percy Sladen Fund.

Remains of mammals and birds, collected by Mr. Turville Petre, from a cave deposit in Galilee; presented by the Council of the British School of Archaeology in Jerusalem.

Pleistocene mammalian remains from Cockspur Street, London; presented by the Sun Life of Canada Assurance Society.

A remarkable specimen of a fossil Angel- or Monk-fish (*Squatina*) from the Upper Jurassic lithographic stone of Bavaria; purchased. This fossil, which is 3½ feet long, hardly differs from the recent form found living in temperate and tropical coastal waters, and is intermediate between the sharks and the skates. It is wonderfully preserved, showing details of the skin and fins. The animal was a male, as shown by the "claspers," which are copulatory modifications of the pelvic fins.

A mackerel-like fish from the Eocene of Monte Bolca, and a fish from the Upper Lias of Holzmaden; a large collection of Tertiary land and freshwater snails from Germany; thin sections of Devonian Chert from Rhynie, Aberdeenshire; and a large Cretaceous ammonite from North America; purchased.

Department of Mineralogy.

A large block (139 lb.) of willemite ore and other fluorescent minerals from Franklin Furnace, New Jersey; presented by the New Jersey Zinc Company for display in the exhibition case that has recently been fitted up to demonstrate the fluorescence of minerals in ultra-violet rays. The pale-green willemite (zinc silicate) is intermixed with snow-white calcite, pink rhodonite, and black crystals of franklinite. Under the influence of the ultra-violet rays the willemite shines up with a brilliant green and the calcite with a rose-red glow.

A large isolated and doubly-terminated crystal of quartz (rock-crystal), weighing 34 lb., recently collected on the Piz Ner, Tavetsch valley, Switzerland; presented by Mr. F. N. Ashcroft.

A handsome block showing the association of white bladed kyanite with emery, from the emery mines of Naxos; presented by Mr. T. Georgacopoulos, Inspector of Mines in Greece.

A series of minerals (including the new truscottite), ores, and rocks, from Sumatra and Java; presented by Mr. C. Joslin Brooks.

A series of alkali-rocks from Pilansberg, Transvaal; presented by Prof. S. J. Shand.

Baltic amber with liquid inclusions and moving bubbles; presented by Mr. C. Ryde.

Crystals of emerald in mica-schist from Ledysdorp, north-eastern Transvaal; presented by the Beryl Mining Company.

Fragments of two meteoric stones recently fallen in India; presented by the Director of the Geological Survey of India.

A meteoric stone from Kansas and a meteoric iron from Utah; acquired by exchange. Other exchanges include fine crystallized groups of wulfenite and descloizite from Chihuahua, Mexico; metavauxite from Bolivia; chromrutile from California; tanteuxenite, a new species, and various other minerals recently described from Western Australia; and crystals of felspar from Cornish china-clay pits.

A unique crystal of herderite (beryllium phosphate) from Bavaria; purchased. Other purchases include vauxite and paravauxite from Bolivia; blue fluorite from the iron mines of west Cumberland; green and purple fluorite from South-West Africa; and rocks from Bohemia.

Department of Botany.

3000 sheets of European specimens, chiefly from Spain and Italy; collected and presented by Mr. C. C. Lacaita.

A valuable collection of 1129 specimens from Yucatan; acquired by exchange from the Field Museum, Chicago.

A series of 870 plants collected in Mexico by Mrs. Ynes Mexia, of the University of California; purchased.

A further instalment of 1237 specimens from Frère Sennen's collections of Spanish plants; purchased.

652 specimens of Indo-Chinese plants from the classic locality in which Joannes de Loureiro made in the eighteenth century the collection (now in the Department of Botany) on which his "*Flora Cochinchinensis*" (1790) was based; purchased.

935 plants from the Ægean Islands and the mainland of Greece, collected by Dr. Rechinger; purchased.

BOOK NOTICE.

Insects: an Introduction to Entomology. By F. BALFOUR-BROWNE. Benn's Sixpenny Library, No. 45. Pp. 80. (London: Ernest Benn, Ltd. 1928. 6d.)

ONCE upon a time there was a series of paper-covered booklets, admirably contrived to satisfy the first cravings for knowledge on the part of the young collector, who is not infrequently compact of the stuff of which the future specialist is made. One of these bygone pamphlets told where to find and how to distinguish British land and freshwater shells; another showed how a bird skin should be made, and so on. In format and appearance the booklets referred to were not unlike the brochure before us, which we accordingly opened in pleasurable expectation of recapturing some of the thrills of early youth. Alas for the vanity of human hope! Professor Balfour-Browne's little volume is not an "*Introduction to Entomology*" at all in any ordinary sense of the phrase. It is true that it contains much interesting information concerning parasitism, biological control, and kindred subjects, but of what use is this to a beginner, who is not told how to distinguish insects belonging to different orders, or why, let us say, a ladybird might justly feel annoyed on hearing a cockroach called a "black beetle"? Even the terms "economic" and "systematic" (p. 32), as applied to entomology, are not explained, although their special meaning is not to be deduced by the light of nature. Limitations of space forbid more extended reference to the author's frequent use of scientific jargon when a simpler phraseology would suffice, except that emphatic protest must be made against the employment of the adjective

"edaphic" (p. 20)—a neologism not to be found in the "New English Dictionary"—and cacophonies such as "polyphagous" and "monophagous," the effect of which on the tyro is likely to be similar to that of the spider upon Miss Muffet. This booklet, however, in spite of its title, strikes us as being more adapted to the purposes of a post-graduate course than to the needs of the beginner. Even so, Professor Balfour-Browne should not speak of "the" mosquito as conveying malaria (p. 14), nor should he term the "common flea . . . a carrier of the germs of plague" (lower down on the same page). In conclusion, it would be interesting to have his authority for the statement that "there are no gall-producers amongst the true flies" (p. 42); and to know why he applies the term "army-worm" to processions of caterpillars (p. 71), instead of to the marching columns of certain larval fungus-midges, upon which the designation "Heerwurm" was originally bestowed in Germany; and why he writes "Gnats and Mosquitoes" (p. 73).

STAFF NEWS.

THE Trustees of the British Museum have, with the approval of the Lords Commissioners of His Majesty's Treasury, reorganized the lower establishment of the Departments and Library into the following series of grades: Technical and Library Assistants (Higher Grade), Technical and Library Assistants (First Class), Technical and Library Assistants (Second Class), Attendants. The grading of the Office and Hall staffs remains unchanged.

Simultaneously the titles of two of the higher grades have been altered, Assistant Keepers and Assistants becoming Assistant Keepers (First Class) and Assistant Keepers (Second Class).

* * * * *

The Principal Trustees have made the following appointments to Assistant Keeperships (Second Class):—

Dr. Isabella Gordon in the Department of Zoology; Dr. Henry Dighton Thomas in the Department of Geology; Mr. Max Hutchinson Hey in the Department of Mineralogy; and Mr. George Taylor in the Department of Botany.

Dr. Gordon was educated at Keith Grammar School and Aberdeen University, where she graduated as B.Sc. in 1922. Subsequently she was engaged in research at the Imperial College of Science, London, and took the degree of Ph.D. (London) in 1926. For the ensuing two years she studied at Yale University—under a Commonwealth Fund Scholarship, and took the D.Sc. (Aberdeen) degree on her return in 1928.

Dr. Thomas was educated at Westminster City School and Emmanuel College, Cambridge. He obtained a first class in the Natural Sciences Tripos, Part I, in 1922, a second class in Part II, in 1923, and the Ph.D. degree in 1928.

Mr. Hey was educated at Balshaw's Grammar School, Leyland, Lancashire, Manchester Grammar School, and Magdalen College, Oxford. He gained a first class in the School of Natural Science (Chemistry and Crystallography) in 1924–25. He was employed as a Temporary Assistant Chemist in the Government Chemist's Department from November 1926 to April 1928, and as an Assistant Examiner in the Patent Office from May to November 1928.

Mr. Taylor was educated at George Heriot's School and Edinburgh University, graduating with first class honours in 1926.

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A DESMAN FROM PORTUGAL.

By MARTIN A. C. HINTON, Deputy Keeper, Department of Zoology.

MR. A. C. KENDALL, a British resident in Oporto, has presented a mounted Pyrenean Desman, or Water Mole (*Galemys pyrenaicus*) to the Museum. This specimen was caught last July in the San Miguel, a tributary of the river Lima in the



DESMAN FROM PORTUGAL.
(Two-thirds natural size.)

district of Vianna do Catello, in the Minho Province of Portugal. Hitherto the species has not been recorded from Portugal, its range being apparently restricted to the Pyrenees and Central Spain. Mr. Kendall has knowledge of two other Portuguese examples. He writes:—"The other one that I saw, say twenty years ago, was in the river Homen, about 15 miles further south [from the place where the mounted specimen was captured]. One other has been seen by an uncle of mine in the river Paiva, district of Vizeu, and about 75 miles further south. This was taken for a fish rising, and my uncle finding it would not take, had a careful look in very clear water and saw the mole walking on the bed, and occasionally it rose to the surface to breathe."

The Desmans are interesting insectivorous mammals specialized for aquatic habits. Although closely resembling Shrews in general outward form, their dental and skeletal characters show that they are more nearly related to the Moles. They have long mobile snouts, completely webbed feet, long, muscular, scaly tails, and soft, velvety fur. They burrow in the banks of streams and ponds and feed chiefly upon insects and crustaceans.

The Common Desman (*Desmana moschata*) inhabits the rivers of Russia and Siberia. It is a larger animal than the Pyrenean Desman, with a compressed instead of a cylindrical scaly tail, and as an "ancient Briton"—for its fossil bones and teeth are found in the Norfolk Forest Bed—is of special interest to British naturalists.

TWO EIGHTEENTH-CENTURY AMERICAN NATURALISTS :

JOHN AND WILLIAM BARTRAM.

By A. W. EXELL, M.A., Assistant Keeper, Department of Botany.

JOHN BARTRAM, who has been called "The Botanical Patriarch of North America," was born near Darby, in Delaware (then Chester) County, Pennsylvania, in the year 1699. As the founder of the first Botanic Garden in the New World, and as an assiduous explorer and collector, he became justly famous not only in his own country but throughout Europe.

His chief English correspondent was Peter Collinson, to whom he sent his diaries, collections of dried plants, and many seeds and living specimens of animals and plants. Collinson, who had acquired an ample fortune in a woollen-drapery business, started a garden at his home at Mill Hill, where many American plants sent to him by his friend Bartram were cultivated for the first time on this side of the Atlantic. In return for these novelties from the New World, Collinson sent back tulips, carnations, clothes for Bartram's children, and sums of money to pay for his collecting expeditions. He writes to Bartram : "All Botanists will join with me in thanking my dear John for his unwearied pains to gratify every inquisitive genius. I have sent Linnæus a specimen and one leaf of *Tipitiwitchet Sensitive*, only to him would I spare such a jewel. Linnæus will be in raptures at the sight of it. . . . The great *rhododendron* has been glorious beyond expression. Think, my dear John, with what amazement and delight I, with Dr. Solander, surveyed

the quire of specimens. He thinks near half are new genera. This will enrich the fountain of knowledge."

Dear Beloved Friend November 7th 1769
 I have now time to write having wrote largely by Captain Falconer, by whom I sent for thee a Box of plants & shrubs in which I put two small harmless snakes I sent also a Box in which I planted many Colocasia roots for y^r King & thy self, I also put two of our large Bull frogs perhaps male & female, which if they come safe & you have none of them before will be a great innocent curiosity for y^r King: they are very harmless if thou wants any of them or any of our tortises I will endeavour to send them, we have a great variety of y^r water kinds that is harmless beside y^e mischievous snapping one that lives mostly on fish & fowls when they can catch them by surprise & they are very dexterous at it, they creep all over in y^e mud except their nose & when a fish swims over them they snap him into their mouths also when young ducks or geese swim over near them they catch hold of their feet draw them under water & devour them, & mankind catcheth all they can, not only to destroy them but they esteem the stewed soup to be a delicious morsell, as most of y^e others are.
 I shall be well pleased if thy Nephew will undertake to receive my salary & y^e Cash for y^e Seed Boxes I shall send for which I am very willing to allow him full Commissions if thou wilt please to let me know by first opportunity. I intend to give him orders to receive give proper discharges
 I remain thy true friend John Bartram

FIG. 1.—LETTER FROM JOHN BARTRAM TO DR. FOTHERGILL.
 (The latter's name is spelt "Fothergil" in the letter.)

Fig. 1 reproduces a letter from John Bartram to Dr. Fothergill, an eminent physician who had acquired a property at



FIG. 2.—ALLIGATOR HOLE.
(William Bartram's Drawings, p. 37.)



FIG. 3.—TURKEY BUZZARD, *Cathartes aura* Wied.
(William Bartram's Drawings, p. 46.)

Upton, in Essex, which he was laying out as a garden, while he was also earning the gratitude of his fellow-enthusiasts by his patronage of Philip Miller in his great undertaking, the "Gardeners' Dictionary." Of the plants and animals mentioned in the letter, the "many Colocasia roots for ye king and thy self" are undoubtedly the American Lotus, *Nelumbium luteum* Willd.; the male and female Bull-frogs, which he says "will be a great inocent curiosity for ye king," have not been specifically identified; of the tortoises "ye mischievous snapping one," which is eagerly sought after because "they esteem the stewed soup to be delitious morcel," is probably *Chelydra serpentina* Linn.

John Bartram had eleven children, of whom his son William, born in 1739, was destined to carry on the work of his father in pioneer investigations of the fauna and flora of his native country. In 1774 William set out on his travels through South Carolina, Georgia, Florida, and Alabama at the request and expense of Dr. Fothergill. His journal and collections of dried plants, and of drawings and paintings representing various plants and animals which he found, are in the Department of Botany. A study of them has recently thrown light on several problems of nomenclature. The various drawings which are here reproduced for the first time show that William Bartram was an artist of no mean ability. As a scientist he had perhaps too strong a tendency towards the picturesque; for his desire to produce an elegant and balanced picture made him disregard to a rather alarming extent the relative proportions of the components of his pictures, the most ambitious of which are composite structures formed by massing together birds, snakes, shells, plants, etc., which he had first drawn separately.

Fig. 2 (Plate II of W. Bartram's Drawings, p. 37) shows a natural hole, which was the home of a vast number of alligators. Bartram gives the following account of the place in his "Travels," published in 1791: "In this place a group of rocky hills almost surround a large bason which is the general receptacle of the water draining from the vast savannah by lateral conduits, winding about and one after the other joining the main creek which at length delivers them into this sink where they descend through rocky caverns into the bowels of the earth. In and about the Great Sink are to be seen incredible numbers of crocodiles, some of which are of enormous size and view the passenger with incredible impudence and voracity; and at this time they are so abundant, that, if permitted by them, I could walk over any part of the bason and the river upon their heads,



FIG 4 —AMERICAN LOTUS, *Nelumbium luteum* Willd
(William Bartram's Drawings, p 49)

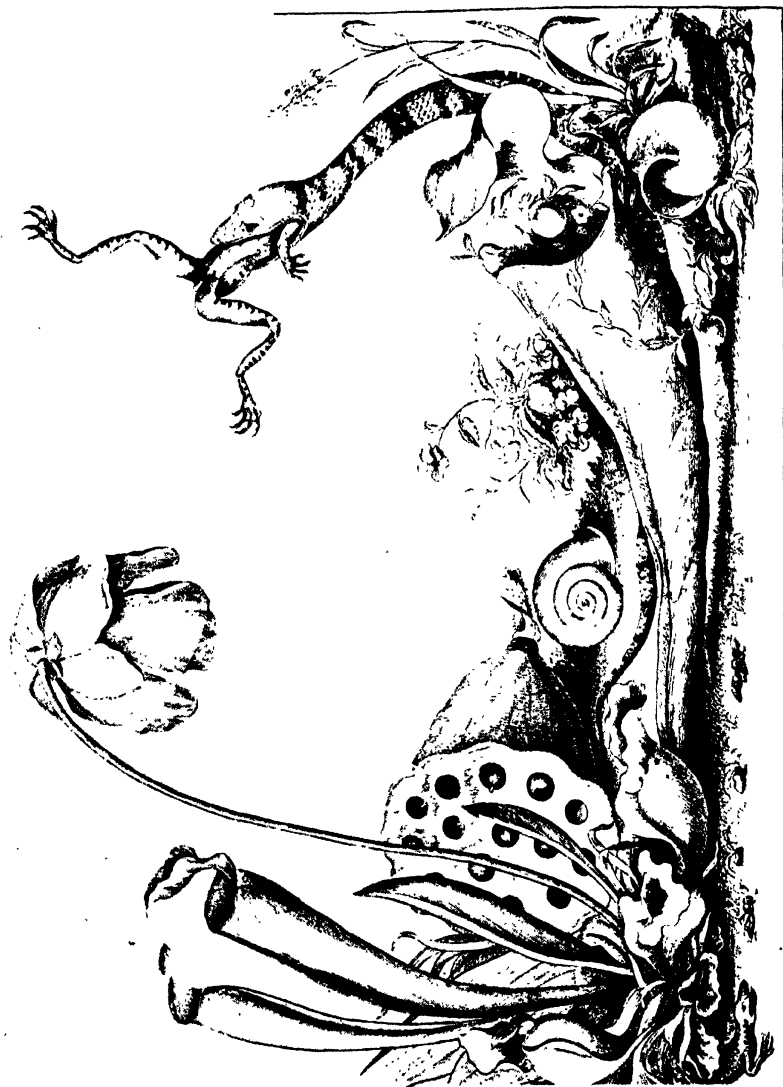


FIG. 5.—PITCHER-PLANT, *Sarracenia flava* Linn.; FRUIT OF *Nelumbium luteum* Willd.; SNAIL, *Polygyra albolabris* Say.; SNAKE AND FROG (unidentified); *Amantium muscaetoxicum* (Walt.) A. Gray (on extreme right).
(William Bartram's Drawings, p. 51.)

which slowly float and turn about like knotty chunks or logs of wood." The alligator is probably *Alligator mississippiensis* Daudin.

Fig. 3 (Plate VII of W. Bartram's Drawings, p. 46) is a well-drawn picture of the Turkey Buzzard, *Cathartes aura* Wied., which plays an important part as a scavenger in the southern United States and in the West Indies.

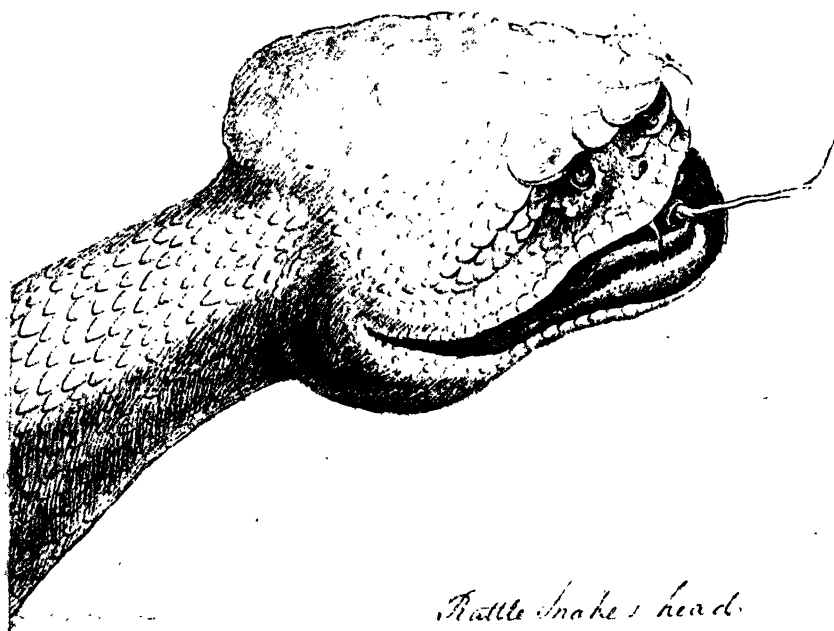


FIG. 6.—HEAD OF RATTLESNAKE, *Crotalus adamanteus* Beauvois?
(William Bartram's Drawings, p. 99.)

Fig. 4 (Plate I of W. Bartram's Drawings, p. 49) shows the American Lotus, *Nelumbium luteum* Willd., called *Colocasia* by the Bartrams. On receiving this picture, Peter Collinson replied in a letter from Mill Hill, dated February 16, 1768: "I and my son opened my ingenious friend William's inimitable picture of the *Colocasia*. So great was the deception, it being candle-light, that we disputed for some time whether it was an engraving or a drawing. It is really a noble piece of pencil-work; and the skill of the artist is shown in following nature in her successive operations. I will not say more in its com-

mendation, because I shall say too little where so much is due." In the bottom left-hand corner of the drawing, Venus's Flytrap, *Dionaea muscipula* Ellis, can readily be identified, but the heron is not sufficiently accurate to be named specifically.

Fig. 5 (Plate II of W. Bartram's Drawings, p. 51) is a composite picture arranged with considerable skill. Prominent in the foreground is a fine drawing of a pitcher-plant, *Sarracenia flava* Linn., behind it is the fruit of *Nelumbium luteum* Willd., and on the extreme right is a rather poor drawing probably meant to represent *Amianthium muscaetoxicum* (Walt.) A. Gray. This is figured far more skilfully in another drawing and has the following note appended: "The Root of this Plant is a most inveterate Poison. In Georgia it is commonly used in houses to kill Flies they mash the Root steep it in Water adding a sufficient quantity of Honey or Treakle to make it acceptable to them they sip the baneful liquid and soon die as if in deep sleep—but erecoverable." The snake, lizard, and frog cannot be identified, but the snail is *Polygyra albolabris* Say.

Fig. 6 (Fig. 1, Plate XI of W. Bartram's Drawings, p. 99) is a drawing of the head of a rattlesnake, probably *Crotalus adamanteus* Beauvois. As the species was neither described nor figured until a later date this was probably the first time it was ever pictured, though the drawing has never previously been published. John Bartram died in 1777 and his son, William, in 1823.

I have to thank my colleagues of the Department of Zoology for some of the identifications.

NOTES ON THE STUDY OF THE WING-PATTERNS OF MOTHS.

By W. H. T. TAMS, Assistant Keeper, Department of Entomology.

IN these days of widespread interest in natural history, there can be few who have not at one time or another noticed the beautiful colours and often striking patterns on the wings of various insects, particularly butterflies and moths. Even in the past some attention was paid to the special study of these wing-patterns, and during the last few years interest in the subject has increased, resulting in the publication of a number of papers on the wing-patterns of butterflies, the most important being certain recent treatises on those of various groups of butterflies of the family Nymphalidæ. The interest taken in moths, how-



A



B



C

WING-PATTERNS OF MOTHS.

A. *Gonometa postica* Walker.

B. *Oplopyra cressida* Druce.

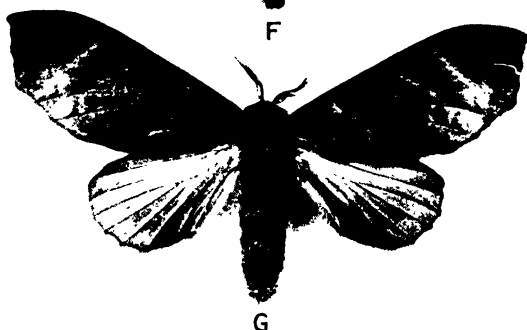
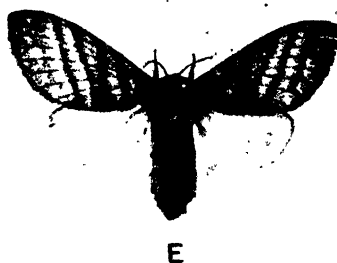
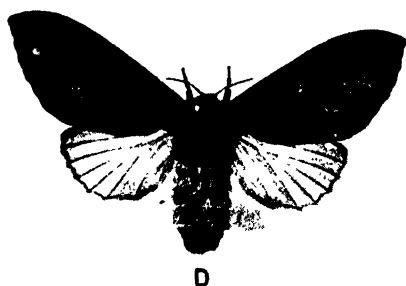
C. *Cataglyphis producta* Walker.

ever, has not been sufficient to induce anyone to make a comprehensive study of their wings from this point of view.

Although the *Natural History Magazine* is not intended to be used for the publication of the results of original investigations, it affords an eminently suitable medium for articles drawing attention to the fields open to those who wish to undertake special work; to the difficulties with which such research workers are frequently faced; and to the actual needs of the British Museum (Natural History) as regards material for carrying to a satisfactory conclusion any investigation that may be attempted.

The material upon which the present article is based has been accumulating in the British Museum since the middle of last century, three of the species figured having been described by Francis Walker in 1855. The number of specimens available of these African moths is still small, and, although the curious patterns to be considered had come under the notice of the writer some six or seven years ago, it is only within the last year or two that sufficient material has come to hand to make even these notes possible. In this connexion it seems desirable to mention that special investigations upon which a member of the Museum staff may be engaged are sometimes held up for years for want of a single specimen or additional examples of a particular species. If this fact were more widely appreciated, at least by those amateurs who know the Museum well and visit it for assistance, the ultimate destination of private collections might be a foregone conclusion. It is perhaps not always realized that, in the case of a Museum which renders not only national but also international service, the best results cannot be attained unless the needs of the institution are not only fully appreciated but generously supplied.

In the early days of descriptive entomology too much attention was often paid to similarity of colour and pattern, with the result that in certain cases quite distinct species were treated as one and the same. As the study of the less superficial structures of insects progressed, the pendulum swung in the other direction, and to "mistrust the obvious" became more general. Colour and pattern were largely ignored in favour of what appeared to be more important features, which again may often be similar in entirely unrelated insects, especially among the butterflies and moths; the result being, as before, the grouping together of insects having little in common. On the other hand, it is becoming increasingly apparent that, in dealing with the Lepidoptera, no detail can be safely ignored if we desire to



WING-PATTERNS OF MOTHS.

D. *Hypotrabala horridula* Tams (female). E. *Hypotrabala dollmani* Tams (female).
 F. *Hypotrabala porphyria* Holland (female). G. *Gonobombyx angulata*
 Aurivillius (female). H. *Pachymeta contraria* Walker (male).

establish a system of classification that may justly claim to rest upon a natural basis.

As an example of an author being misled by a general resemblance we may take the moth *Opломета cassandra* Druce (Fig. B), belonging to the subfamily Lasiocampinæ of the family Lasiocampidæ, which includes among others the moths known familiarly as Lappets, Eggars, Drinkers, and Lackeys. This very striking moth was described by Druce in 1887 as *Gonometa cassandra*. The various species which are grouped together in the genus *Gonometa* include one known as *Gonometa postica* Walker (Fig. A), which certainly resembles *Opломета cassandra* to a remarkable degree, so much in fact that the statement that the two species are similar in facies (general appearance) would seem to be justified. *Gonometa postica*, however, belongs to a different subfamily (Gonometinæ) of the Lasiocampidæ. There are various means by which we are able to satisfy ourselves as to the degree of relationship existing between any insects with which we may be dealing. In the case of moths, we make use of the arrangement of the veins in the wings, of the structure of the terminal segments (rings) of the abdomen and the structure of the mouth-parts. The writer made the discovery that *Opломета cassandra* was not a *Gonometa* through studying the terminal segments of the abdomen, particularly the 8th and 9th, the former of which is often, and the latter always modified in connexion with the male genital armature in these moths. In *Opломета cassandra* these structures were found to be similar to the corresponding segments in *Catalebeda producta* Walker (Fig. C). A comparison of the wing-veins of the two moths confirmed the previous findings, and a further examination produced the following interesting results. The important features in the facies of *Opломета cassandra* appear to be the very curious zig-zag velvety brown fascia (*i.e.* band, in this case consisting of a more or less interrupted dark line outwardly edged with light buff) on the fore wing, and the apparently "inlaid" tuft of buff scales on the thorax behind (technically on the scutellum of the mesothorax). These characters would almost certainly have been regarded as trivial by Druce, whereas we are able to show that they are in this case of definite value for grouping species into a genus. On the other hand, the similarity in shape and general appearance, which deceived Druce, does not, in this case, indicate any relationship between *Opломета cassandra* and *Gonometa postica*. It is evident, then, that we need to be careful when we talk glibly of the facies of an insect.

Only one specimen of *Opломета cassandra*, viz. that on which

Druce based his original description, is known. This example (Fig. B) is now in the British Museum, and is not in good condition, the thorax in particular having lost nearly all its scales; but there remain a few buff scales in a similar position to that occupied by the tuft ("inlaid") on the thorax in *Catalebeda producta*. Previous to the discovery that *Gonometa cassandra* Druce belongs to *Oplometa*, only one other species of that genus was known, namely, *Oplometa cornuta* Aurivillius. In the description of the latter species there is no mention of any buff scaling on the thorax, so that in default of specimens of *Oplometa cornuta* Aurivillius, we do not know whether in *Oplometa* these scales are actually visible or buried in the general vestiture of the thorax. In the genus *Catalebeda* they form a striking feature in the pattern of the thorax in the few known species.

In another Lasiocampid genus, *Hypotrabala*, belonging to the subfamily Gonometinæ, the wing-pattern in the case of several species exhibits a curious deviation from that which may be regarded as normal for the genus. This so-called normal pattern, *Hypotrabala horridula* Tams (Fig. D, female) is common throughout the Lasiocampidæ, and is, moreover, one exhibited by moths of many different families. In *Hypotrabala dollmani* Tams (Fig. E, female) may be seen a curious if not very divergent modification of the normal pattern. A much more striking divergence is, however, to be noticed in the pattern of *Hypotrabala porphyria* Holland (Fig. F, female). But the most remarkable fact in connexion with this pattern is that it is displayed by moths belonging to two other genera, distinct from *Hypotrabala* and from one another, though all three appear to be related—*Gonobombyx angulata* Aurivillius (Fig. G, female) and *Pachymeta contraria* Walker (Fig. H, male).

No observations on the appearance of these moths at rest appear to have been published; yet information of this kind, accompanied if possible by photographs showing the relationship of such a pattern as that described above to the immediate environment of the insect, is much to be desired. Indeed, it may be stated emphatically that these are not the only moths, or, in fact, insects of any order, in connexion with which such observations are needed, and it is to be hoped that this article will fall into the hands of those who are in a position to make such researches in the field, be it only with regard to a single species.

A SOUTH AFRICAN GIRAFFE.

By J. GUY DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

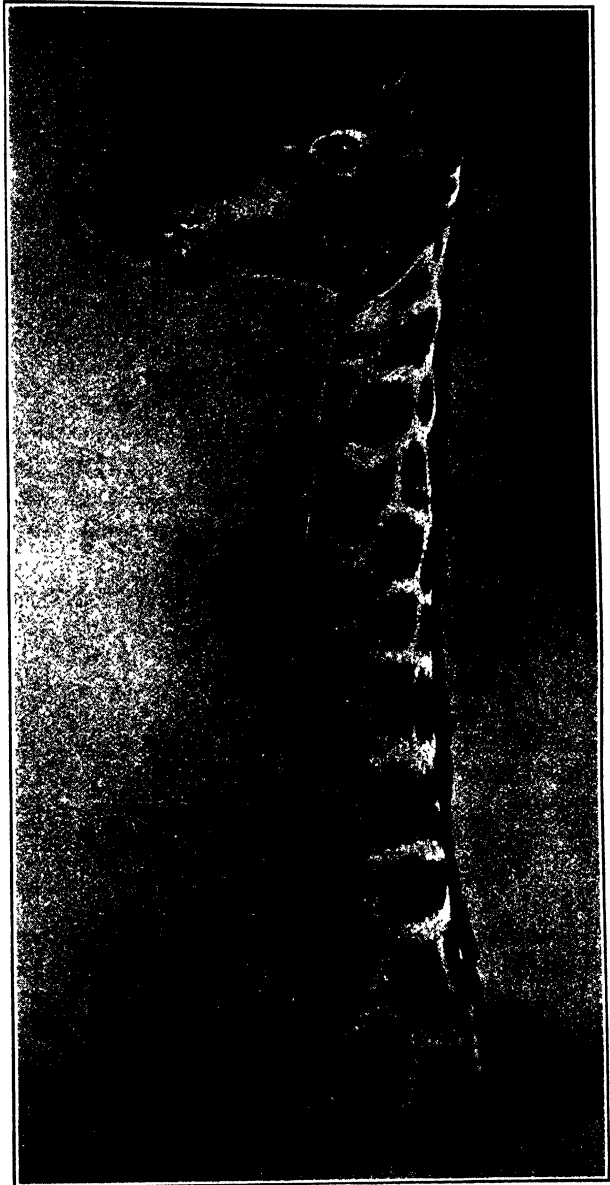
THE Giraffes and Okapi are the only living representatives of the family *Giraffidae*, a group of African ruminants in which the horns are comparatively short and covered over with skin; these horns may be present in both sexes (giraffes), or only in the males (okapi), in the latter the tips of the horns being bare and bony. The family is further distinguished by the shape of the outermost of the four pairs of lower front teeth and the rugose structure of the enamel. Lateral hoofs are wanting, as in the Impala. At the present time the members of this group are confined to the African continent south of the Sahara; in the Tertiary period the distribution included a portion of Europe and a large extent of Asia.

Giraffes have, besides the pair of conical, skin-covered horns on the top of the head, a shorter horn in the middle of the forehead, and in some instances a pair of rudimentary horns is developed at the back of the skull in the occipital region; in young giraffes tufts of hair grow in place of the horns.

There are two species of giraffe existing at the present day, the Somali or Reticulated giraffe (*Giraffa reticulata*), which is confined to parts of north-east Africa, and the common giraffe (*Giraffa camelopardalis*), which is widely distributed over a great extent of the continent, from Lake Chad and Nubia in the north southwards to South Africa. A large number of local races have been described, the most noteworthy of which are the following:—the Nubian giraffe (*Giraffa camelopardalis camelopardalis*), the typical form from Upper Nubia and Abyssinia; this animal, in common with many of the other northern races, has a large frontal horn in the males and has the fore-legs, from the knees downwards, white and unspotted. Prominent occipital (posterior) horns are developed. Closely allied to the typical race is the Kordofan giraffe (*G. c. antiquorum*), in which the spots on the upper parts of the limbs are small and irregular in shape. In north-west Africa there is a very pale coloured form known as the Nigerian giraffe (*G. c. peralta*), which, in spite of its name, is no larger than the other races. Specimens of this western desert-living giraffe have recently been obtained in the Shari River district by Major P. H. G. Powell-Cotton; the type locality of the race is the junction of the Benue with the Niger, so that the distribution is evidently extensive.

A much darker race is the Uganda or Baringo giraffe (*G. c. rothschildi*), which occurs in Uganda and Kenya Colony; this giraffe is a very dark coloured animal with the spots star-shaped or jagged in outline. The skull of *G. c. rothschildi* is very heavily built and the frontal horn unusually well developed; the main pair of horns is very massive and in old animals bony excrescences resembling horns frequently occur. The Kilimanjaro giraffe (*G. c. tippelskirchi*) is a closely allied race which differs in having the lower part of the limbs spotted; it inhabits the country to the south of the Victoria Nyanza and extends southwards through the greater part of Tanganyika Territory, possibly penetrating as far south as Portuguese East Africa.

The late Dr. Paul Matschie gave the name of *G. c. schillingsi* to a giraffe from the Kilimanjaro district; this name, however, cannot be regarded as anything more than a synonym of *G. c. tippelskirchi*. From



HEAD OF SOUTH AFRICAN GIRAFFE.

Northern Rhodesia the late Richard Lydekker described a giraffe under the name *G. c. thornicrofti*; this form appears to be a near relation of the Kilimanjaro or Masai giraffe but has a smaller anterior horn. In the Congo there is yet another form, *G. c. congoensis*, characterized by the large size of the anterior horn, full spotting of the legs, and large size of the body markings; the latter do not exhibit the stellate tendency seen in the East African races, being, for the most part, subquadrangular in form. This giraffe resembles the South African race, *G. c. capensis*, in having the legs spotted to the hoofs, but the sides of the head are more heavily marked and the tail appears to be provided with a larger tuft. Further south in Angola there occurs another race, *G. c. angolensis*, in which, as in the remaining races, the frontal horn is much reduced in size, being represented by only a low swelling. In *G. c. wardi*, from the northern Transvaal, in addition to the small size of the anterior horn, the posterior, or occipital pair are very large, giving the animal a four-horned appearance. The body markings are in the form of irregular star-shaped blotches, resembling the pattern of the Kilimanjaro giraffe, but deep chocolate-brown in colour, not chestnut-red.

Lastly, there is the South African giraffe, *G. c. capensis*, which is the most southerly race known. It is a large dark-coloured animal, with dark brown body markings more or less quadrangular in form, without exhibiting any trace of the stellate pattern; the ground colour of this giraffe is tawny and the legs are fully spotted. As with the other southern races the anterior horn is rudimentary; occipital horns are not developed in this form. It occurs in the country lying just to the north of the Orange River and adjacent districts; whether this giraffe was, in spite of its subspecific name, ever found to the south of the Orange River is a problem which will never be solved. There exists, however, a sort of tradition among the Hottentots that giraffes once inhabited the Queenstown province of Cape Colony. For a number of years no giraffes have been found in the eastern part of the continent to the south of the north-eastern Transvaal. These animals have disappeared from the greater part of South Africa, and in many of their former haunts they are now rarely met with. In the days of Gordon Cumming large troops of these beautiful creatures were to be seen as a daily occurrence, and as late as 1880, when Selous was hunting, numerous parties of giraffes were to be encountered on the vast plains between the Zambesi and Orange Rivers. In other parts of South Africa, such as the northern Kalahari,

these beasts are still to be found in fair numbers. The South African giraffe also occurs in Portuguese East Africa and in some of the game reserves of the eastern side of the continent. The specimen illustrated, which comes from Matabililand, may be considered to represent this race; it was presented to the Museum by Messrs. Rowland Ward, Ltd., in whose studios it was modelled.

North of the Zambesi the giraffe is still a fairly common animal, and in East Africa herds of considerable size are occasionally seen. There is no doubt that all these races of giraffe are very closely allied and grade one into the other, so much so that some of the distinguishing characters made use of in the diagnoses of the various subspecies may be little more than herd characters. It is possible that when more is known about the relationships of these various giraffes the Somali, or Reticulated Giraffe will have to be considered as a race of *camelopardalis*.

A CANADIAN ARMoured DINOSAUR.

By W. E. SWINTON, B.Sc., Assistant Keeper, Department of Geology.

FEW groups of vertebrate fossils are so interesting as the Dinosaurs, and of these the Armoured Dinosaurs are outstanding for the variety of form and dermal ornament which the various families show. Moreover, it is remarkable that, while the remains of other herbivorous and carnivorous dinosaurs of the same period are not uncommon, traces of the armoured types are rare. Most of the genera and species so far described were collected from American localities and have been placed in American museums, and it is of particular interest therefore that our Natural History Museum contains the most complete specimen so far found.

In 1914 Mr. W. E. Cutler, who subsequently died while collecting for the Museum in East Africa, obtained the skeleton of a dinosaur in the Upper Cretaceous sandstones of Alberta. The actual locality of the find was half-way, that is to say two hundred feet, from the top of Dead Lodge Canyon, which lies about half a mile below Happy Jack Ferry on the Red Deer River. The sandstones belong to the Belly River Series. The fossil was removed in a number of large blocks, and the visible bones were wrapped in plaster bandages before being packed and shipped to the Museum in 1915. Mr. L. E. Parsons, one of the geological preparators, had time only to unpack and look over the specimen before leaving the Museum on military

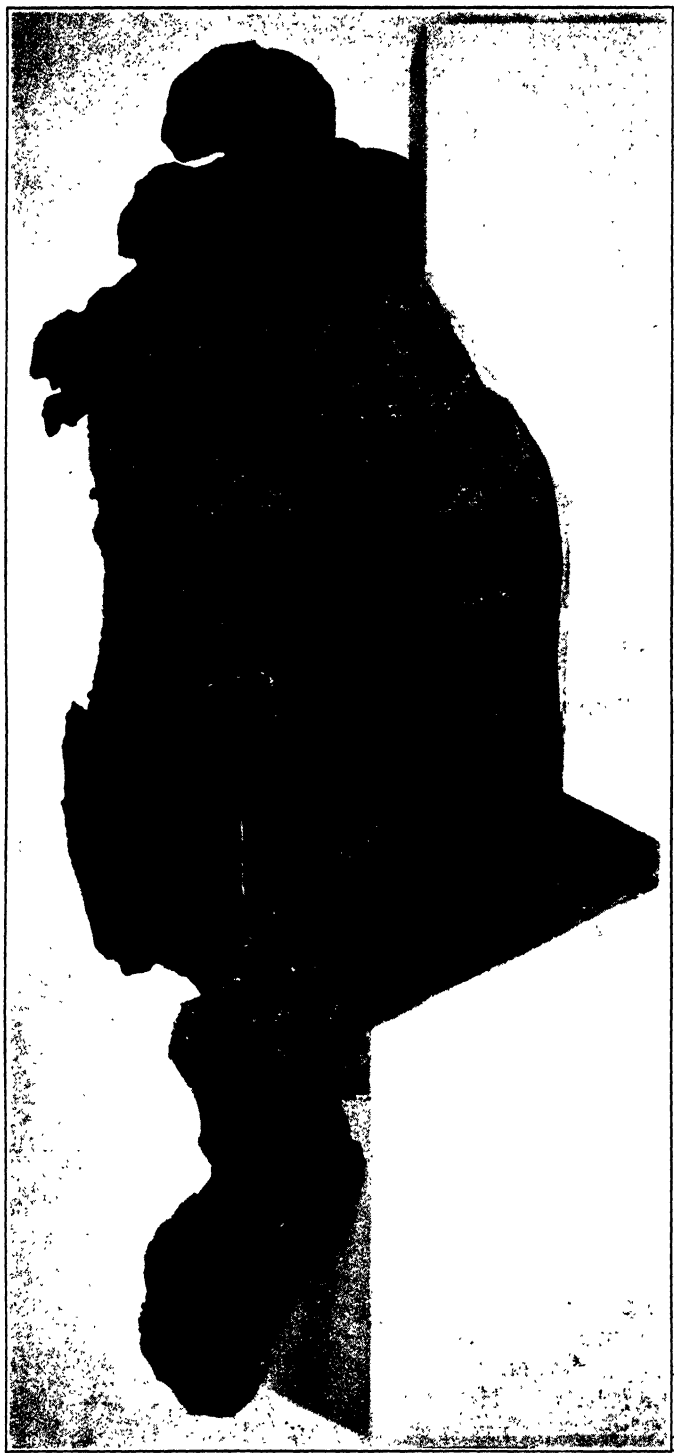


FIG. 1.—BACK OF THE DINOSAUR, SHOWING IMPRESSIONS OF SKIN AND ARMOUR.

service, and it was not until he returned in 1919 that he actually began to develop the fossil. First the massive blocks were fitted together, and then, by the use of hammer and chisel, the sandstone matrix was gradually removed from one side to reveal a great portion of the skeleton in excellent condition. It was while trying to uncover the skeleton from the reverse side of the slabs that the preparator encountered a brown-coloured layer of sandstone with peculiar ornamentation which, on further investigation and with extremely careful work, proved to be the impression of the skin. It should be realized that this brownish deposit was not the original skin, but merely the impression made by the skin on the fine sand or mud on which the animal lay supine while dying and after it was dead. Obviously the very greatest care and skill had to be exercised before the whole of this thin and delicate surface was exposed. During the work several kinds of skin-impressions were found, the pattern of the original skin was revealed, and hundreds of little ossicles were seen and developed in what must have been the more flexible regions of the skin. Besides these, paired series of large bony spines and plates were uncovered, so that the complete preparation showed an exceptionally well-preserved dorsal armour; indeed, the whole specimen may certainly be claimed as the finest armoured dinosaur so far known.

Naturally all this work took a long time, and it was not until 1925 that the specimen was ready for examination by Baron Nopcsa, who some time previously had been requested by Dr. F. A. Bather to undertake its scientific description. Although the dinosaur has been exhibited continuously since 1925, its scientific description was unpublished until this year. This unfortunate postponement has necessarily delayed the appearance of any popular description.

Armoured dinosaurs may roughly be divided into those which carry outstanding armour on the head in the shape of bony frills and horns (such as *Triceratops*, *Centrosaurus*, etc.); and those with plates, spines and bones on the body. That here described is known as *Scolosaurus cutleri*, and belongs to the latter group. Unfortunately the skull is missing; but a large part of the skeleton is preserved as well as almost the whole skin, or its traces, from the neck to the tip of the tail. Since this is unique, the skin is worthy of detailed description. Impressions of the skin with its ossifications are preserved on the back of the neck and body, on most of the tail, and on the outer side of the left upper arm. A few traces are observable also on the ventral side of the tail and the shoulder region. - A

glance at the general appearance of the specimen (Figs. 1 and 2) is sufficient to show that the skin was divided into flexible and inflexible areas. The inflexible areas, or armoured segments, are of unequal size and made up of ovoid, elliptical and polygonal markings. Closer inspection shows that the more centrally placed markings on the segments are polygonal, but that they become shorter and broader as they approach the anterior and



FIG. 2.—PREPARING THE ARMOUR.
(Photograph by permission of Special Press Limited.)

posterior margins of the segments. These markings represent what must have been rigid, flat, horny scutes, so arranged that the whole armoured segment must have been rigid, or at least incapable of folding, and comparable in this respect to the thicker skin of a rhinoceros. The segments of more or less immobile skin are sharply demarcated one from another by narrow belts of thick, but flexible, granular skin heavily charged with small ossicles. These flexible granular regions, with one exception, seldom exceed 4 centimetres in an antero-posterior direction. Each shows the marks of several folds, and contains

hundreds of very small, hard, bony granules. Besides the flat scutes and small ossicles there is a third type of dermal armour, namely, large bony spines and bosses, which are restricted to the inflexible skin, one row of the spines being developed on each segment.

The general distribution of the dermal areas may be shortly summed up as follows. The neck region is protected by two transverse bony strips, named by Nopcsa "nuchal plates." They are separated by a short strip of flexible granular skin. The nuchal plates are followed posteriorly by a large, broad and comparatively long patch of flexible granular skin, the lateral borders of which are indented where the fore limbs with their protecting cover of skin and spines meet the body. Then come four transverse strips of inflexible skin, averaging 25 centimetres in antero-posterior length, and separated by narrow belts of flexible skin. The four strips and the cervical plates serve to protect the anterior part of the body, while the posterior part is covered by a large, rigid plate apparently formed by the fusion of three segments of inflexible skin with polygonal scute-traces. This is suggested by the fact that, though the preceding segments each bear one row of spines, this plate has three rows. It thus forms a lumbar shield, comparable to that of *Polacanthus*, the Wealden armoured dinosaur from the Isle of Wight. The shield is followed by the alternating, polygonally-marked segments and granular skin of the tail. The complete tail is not preserved, but it was probably protected by some five segments. The spines, bosses and plates are distributed symmetrically over the segmented horny cuirass. Their remains show that, starting at the first segment, two longitudinal rows of spines ran along each side of the back; while starting at the third segment, a third series was intercalated between the members of the other two and ran to the hinder end of the lumbar plate. The anterior spines of the innermost series are blunt conical bony projections, 15 centimetres high, posteriorly becoming flatter, and eventually passing into round plates. The outermost series are somewhat similar, but show greater variation, while the intercalated rows consist only of flat plates of more or less circular outline. Spines also occur on the two cervical plates, while a whole battery of sharp-pointed spikes is arranged to cover and protect the upper arm. On the tail the spines again increase in size, until the last segment but one, which carries two great spikes, whose use it is rather difficult to imagine. This part of the tail was no more vulnerable than the anterior portions, while the tail appears to be too thick and clumsy to be used in offence like a

Crusader's mace. No doubt during life the spikes and bosses had a sharper horny covering. The arrangement of the whole series is excellently shown on the model (Fig. 3).

As the skeleton lies, the hind limbs appear to be longer than the front, but this is actually due to post-mortem displacement. Fortunately the left front limb is preserved in its natural position, namely, with the humerus horizontal and at right angles to the radius and ulna. There is no doubt that the hind limbs were similarly set, which would mean that *Scolosaurus*, like other heavily armoured reptiles, walked with the feet wide apart, and consequently had a very small stride. Its gait must have

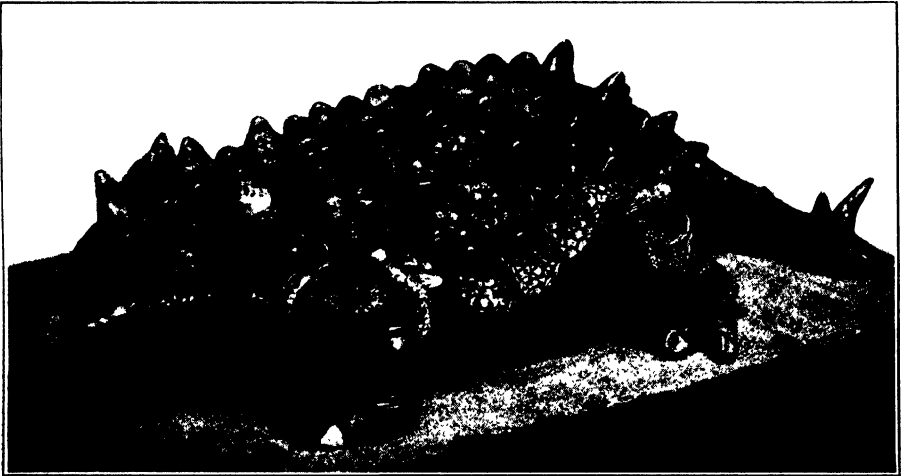


FIG. 3.—RESTORATION OF THE DINOSAUR.
(Modelled by Vernon Edwards.)

been exceedingly slow and awkward, and the whole animal must have appeared something like a very large, spiky and heavily tailed tortoise. The total length is nearly 18 feet, the greatest breadth 8 feet, and the height 4 feet, while the weight has been estimated by Baron Nopcsa at nearly two tons. When attacked by even its most formidable enemies *Scolosaurus* must have been a difficult proposition, and the low, broad body would be almost impossible to upset, though if once turned on its back the animal would be absolutely helpless.

Not the least interesting problem in connection with *Scolosaurus* concerns its habits. Though heavily armed against its predaceous contemporaries, it had but a small and undoubtedly lowly-organized brain. How then did it manage to obtain its food and overcome the difficulties of its environment? The

sandstone in which the remains are preserved is of æolian origin, and the fact that a well-preserved and apparently dried leaf of a plane tree was found in the body-cavity indicates that the creature did not become embedded in water-laid sediments. Unfortunately the skull was not collected, so that direct evidence of the dinosaur's feeding habits is wanting. Baron Nopcsa holds that the creature was desert-living, and bases his assumption both on the conditions under which it was preserved and on its general similarity in appearance to *Molochus* and *Phrynosoma*, modern lizards which live in desert or semi-desert regions, where their squat bodies lie flattened and more or less hidden on the sandy surface. Their spines protect them from attack, and they eat insects. Now *Scolosaurus* died in a sandy region, and being very clumsy it is difficult to believe that it travelled very far or fast to obtain food. Accordingly, Baron Nopcsa has put forward the very ingenious suggestion that it was insectivorous, and he has calculated that it probably ate 7000 grasshoppers and beetles a week. This would mean that the dinosaur was the largest insectivore so far known. Naturally the characters of the teeth, and the strength and condition of the jaws, would be very helpful in determining its diet, and although this direct evidence is not available for *Scolosaurus*, the skulls of allied dinosaurs are well known. In such forms the feeble quadrates certainly indicate that no great pressure was brought to bear on them, and that the food was probably soft. On the other hand, the teeth are frequently reduced, which suggests that the food was not cut up, and consequently most types of desert vegetation must be excluded as articles of diet. Baron Nopcsa has therefore very good grounds for his interesting suggestion. There are, however, equally good grounds for a less sensational view. If we study the rocks of the region where *Scolosaurus* was found, we see that this district was a great well-watered delta, quite capable of supporting a good vegetation—indeed, the leaf found in association with the skeleton is proof that trees existed at no great distance from the sandy spot where the animal died. Much of the ground must have been swampy, and entirely unsuitable to the heavy, slow-moving *Scolosaurus*; but there is no reason why the vegetation should not have been quite close to the numerous sand-dunes which must have occurred, and this sandy ground would provide good foothold and adequate vegetable diet for the dinosaur. His contemporaries, *Palæoscincus* and *Panoplosaurus*, are generally supposed to have lived under these conditions, and the insectivorous diet suggested by Baron Nopcsa for *Scolosaurus* does not appear to be by any

means inevitable. It is almost certain, then, that an abundant supply of suitable plants and trees existed in the area in which *Scolosaurus* lived: the heavy armour was sufficient protection against the very large carnivorous dinosaurs of the time: while the low body position made it almost impossible for the creature to be pushed over when attacked. Very likely the soft sand of the dunes gave way suddenly under one side of this particular dinosaur, which then rolled on its back, a position in which it was quite helpless, and in which it met its death. Then apparently the body-cavity opened, letting in the sand and the plane leaf, and finally the whole carcass became embedded in wind-blown sand. In the course of time the sands hardened into sandstones, which were re-excavated by the Red Deer River, and once more the dinosaur was brought into the light of day.

The specimen is on exhibition in a centre case near the east end of the main fossil reptile gallery in the Geological Department, and is mounted on its right side so that both the skin on the back and the skeleton underneath it are clearly displayed. The model (Fig. 3) is on show in the same case.

THE BUSHMAN'S ARROW-POISON BEETLE AND ITS PARASITE.

By JAMES WATERSTON, M.A., D.Sc., Assistant Keeper, Department of Entomology.

AMONGST the many substances smeared by primitive tribes on their weapons for hunting or fighting, none is more remarkable in its origin or more deadly in its effects than the "N'gwa" arrow poison of the South African Bushman, which is derived from the larva of a beetle. The practice of anointing arrows with this poison has lasted from ancient times to the present day, and there has arisen an extensive literature dealing with the subject. Concerning the general effects of the poison the older writers give us many picturesque passages. "The Bushmen of the northern part of the Kalahari," says Livingstone, "were seen applying the entrails of a small caterpillar which they termed N'ga (N'gwa) to their arrows. The venom was declared to be so powerful in producing delirium that a man in dying returned in imagination to a state of infancy and would call for his mother's breast. Lions when shot with it are said to perish in agonies."

According to Baines the caterpillar in question feeds on a tree, called by the natives "Maruru papeerie," about the size of an elm, with thorny stem and branches. When full fed and

about three-quarters of an inch long, the grub descends to the ground, in which it forms a cocoon of earth or sand for its further transformation.

The adult beetle (Fig. 1) has received many names, the oldest being *Cladocera nigro-ornata*. The family to which it belongs (Chrysomelidæ) includes among more familiar forms the well known "Flea" Beetles (Halticinae) and the Asparagus Beetle. *C. nigro-ornata* appears to be toxic at all stages, but for arrow poisoning only the grubs or the pupæ are employed. Injection of the venom is fatal to all mammals, but has no, or at least no certain effect in the case of birds, fishes and reptiles.

For several years specimens of the Beetle and its grub have been exhibited in the Insect Gallery of the Museum, and our interest in the species has recently been revived by the reception of living cocoons from the south-west region of the Kalahari Desert, sent to Mr. P. A. Buxton, of the London School of Hygiene and Tropical Medicine, by Dr. L. Fourie. Part of this material was forwarded to the Insect House of the Zoological Society of London for exhibition, and from both series of specimens, examples of the remarkable

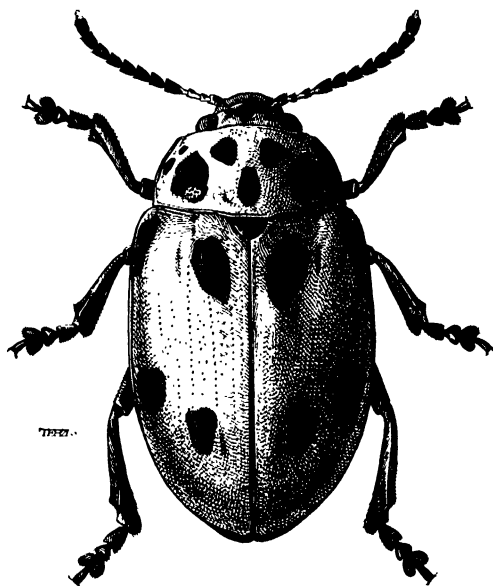


FIG. 1.—THE ARROW-POISON BEETLE
(*Cladocera nigro-ornata*). $\times 5$.

parasite, shortly to be more fully described under the name *Belesica braconoides*, were reared. This parasite—an Ichneumon Fly (Fig. 2)—has an unusually large and square head, with a curious tooth between the long antennæ. Like the Beetle, it is yellowish-red or brown in colour, with darker wing-markings, which are extremely variable in shape and extent. The spots on the beetle also vary in number and size. Seeing that all the relatives of *Belesica*, whose life history is known, attack Sawflies, the new parasite has completely broken with family tradition as regards the character of its host, and is altogether a remarkable insect.

Since the study of the beetle and its parasite has involved a

review * of a large part of the literature dealing with the Bushman's weapon and methods of poisoning, I have summarized below what is known regarding the use of N'gwa for this purpose.

The Arrows.—The arrows of the Bushman are of many patterns and materials, varying in detail partly with their purpose and partly with locality or tribe. The same hunter may use several kinds of arrow, amongst which earlier and more modern types persist side by side. Speaking generally, arrows employed for small game are about two feet long, while those used in shooting larger animals measure three feet in length. But whatever its length the arrow consists essentially of a reed shaft one-and-a-half to two feet long, and a head measuring from six to ten inches, the latter part being sometimes a rather complex structure. The reeds used for the shafts are not generally distributed but grow only in restricted localities, *e.g.* at Rietfontein. In what appears to be its most primitive condition, the arrow-head is a strip of bone taken from the thigh of an ostrich or the fore leg of a kudu—the former being preferred because of its superior hardness and toughness. The head is prepared by scraping it down to a long, fine point at one end and more shortly and bluntly at the other. Its maximum width is about a quarter of an inch near the blunter end. The tapering end after receiving the poison is slid into its hollow reed shaft. When the arrow is required for use, the head is reversed and fixed by simple pressure of the blunt end into the extremity of the shaft. It is then ready to be discharged. The penetrating power of the head may be increased by means of a triangular tip of flint, agate or chalcedony let into the bone. Numerous chipping-places, for the preparation of such heads and other stone implements, are known to have been worked within the present century, and a Bushman, confronted with the problem of an antelope newly shot by a white hunter who had forgotten his knife, was observed to take two stones, chip a cutter with one from the other, and with this improvised tool skin and prepare the animal. A like adaptability is shown in choosing the material for the arrow-tip, since the Bushman readily replaces the triangular flint chip by a fragment of broken bottle from the veld. The tips just described are not firmly fastened, but about an inch and a half further back on the head a piece of quill is usually inserted to make a barb. The quill is fastened with sinew wrapped round several times. This is on the poisoned portion

* The author's thanks are due to Mr. H. J. Brauholtz, M.A., Department of Ceramics and Ethnography, British Museum, for assistance in connexion with the literature.

of the head, and, even if the tip is detached after an animal is shot, the arrow will still do its deadly work.

The arrow-head may be further elaborated and consist of a tip, lance-headed and barbed, about two inches long, inserted in a piece of hard wood carefully smoothed with a scraper and then tied with gut, sinew or grass to a little shaft four to five inches in length. The entire head, which may be as much as seven inches long, is thrust loosely into a reed shaft, and the arrow is launched

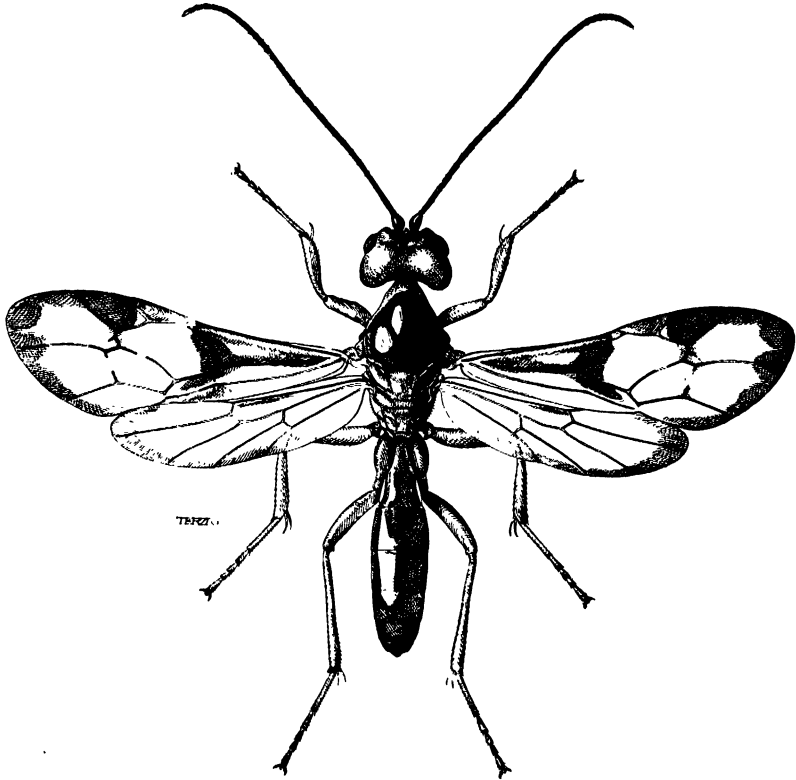


FIG. 2.—A HYMENOPTEROUS PARASITE (*Belesica braconoides*) OF THE ARROW-POISON BEETLE (*Cladocera nigro-ornata*). Male. $\times 10$.

from the bow. When an animal is struck by any of the arrows described, the reed shaft falls to the ground.

At a later stage in the evolution of the Bushman's arrow, iron replaced the flint tip, and to a greater or less extent the head might be provided throughout with barbs, cut or worked in the metal itself. Iron-headed arrows, the heads of which are fixed and never reversible, are naturally enough used for larger game. For tipping arrows, old nails are much sought after, but some tribes appear to have more regular sources of supply.

"The metal for these heads is purchased from the north, probably from the Ovambo, by the Auen, who cut the iron to shape, a flat head with two backward points at the sides on a short iron shaft. . . . The Naron say they make the bone arrow-heads, and the Auen the metal ones, but the Auen claim to make both kinds."

It is perhaps worth noting here, before passing from the weapons themselves, that arrow poison is also applied to assegais used in killing elephants and the largest game animals.

The Poison.—The Bushman's poisons are derived from many animals and plants. The three main poisons of animal origin are snake venom, spider venom, and the active principle in "N'gwa"—the Arrow-Poison Beetle larva. Among the vegetable components may be mentioned the juice of various species of *Euphorbia* (Milk Weeds); the bulbs of *Buphane distichia* (an Amaryllid); Bushman's Poison Bush (*Acocanthera venemata*); *Strychnos toxifera*; and the Spiked Cucumber (*Citrullus caffer*).

On examining an arrow-head one may find the poison in either of two forms: (1) a broad, dark brown, rather thick band of sticky material extending for a short distance behind the tip (Fig. 3, II); (2) a number of closely set, pale, isolated droplets covering the same area (Fig. 3, I). The latter is pure N'gwa poison, applied briefly as follows, without special preparation. In January or February, taking the full-grown larva of the beetle as it descends to pupate, or the pupa itself, the Bushman squeezes it between the fingers of his right hand (having first examined his hands to make sure that the skin is nowhere broken) until the gut-contents and juices begin to exude. In his left hand, with the tip pointing away from him, is the arrow-head. The caterpillar is now applied, and drops of the exudate deposited closely in a longitudinal row. The head is then turned, and the operation repeated until the surface has been treated sufficiently. When the droplets are dry the arrow is ready for use. N'gwa may also enter into the composition of the dark arrow poison first mentioned. In this case the grubs or pupæ are dried in the sun, and remain virulent for at least a year. When wanted, the dried grubs are rubbed to powder in a tortoise shell which has been cut in half, and then mixed with the heated juice of the Spiked Cucumber. Next the bark of the "Hak-Doorn" is chewed, and the juice spat into the dish of poison. The result is a clear, bitter, sticky juice, which is daubed on the arrow by means of a flattened stick.

Another method is to heat together the juices of the Milk

Weed and the Amaryllid with scrapings from the root of the Bushman's Poison Bush, and add the powdered grub as before. When the mixture becomes sticky enough, it is poured into moulds having a central hollow from which run lateral grooves; in this way the poison is prevented from touching the hands. The arrow is now gently pushed into the central channel, and coated with the poison by turning.

The whole operation of poison-making is regarded as magic, and is accompanied by the singing of weird chants to make the poison more virulent. During the process the Bushman takes the utmost care to prevent any cut in his skin from coming into contact with the poison, which can otherwise be safely handled so long as it is moist. When dry it throws off a dust, which is very irritating to the mucous membranes, *e.g.* of the eye. For

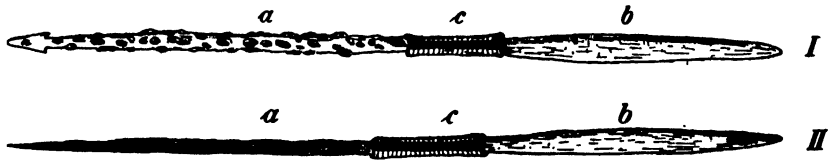


FIG. 3.—BUSHMEN'S POISONED ARROW-HEADS.

I, head (formed of a shaped strip of bone) covered with dried droplets of N'gwa poison.
II, head uniformly smeared with a blackish-brown coat of poison.

a, tip; b, butt-end of bone head; c, grass-stem hand-guard. (After Passarge.)

this reason the hunter rarely carries the poison with him, but only the treated arrow-heads, which are often placed in a separate case within the leather or bark quiver. Space does not permit any description of the Bushman's bow or its use; it may, however, be mentioned that accurate shooting seems possible up to about 50 metres, though beyond that range the penetration of the arrow is slight.

Much has been published as to the nature and source of the poison itself. According to one writer, the grub is not poisonous when reared on *Geranium*, but only after feeding on the spiky, soft-wooded Thorn Tree, under which the Bushman gathers it. This tree is referred to by the German traveller Schinz as *Commiphora africana*. The genus *Commiphora*, however, includes many species between which it is difficult to discriminate, and Dr. J. M. Dalziel informs me that *C. africana* does not reach the Kalahari region. The food-plant of the larva of our *Cladocera* then can only be described as a species of *Commiphora*. In this group of plants only one, which is found in Somaliland, is reported to be poisonous, while from others are

produced myrrh and African bdellium, which are commonly chewed. It therefore does not seem likely that the food-plant is the source of the poison, though the point is open to argument. It should be remembered that many beetles nearly related to *Cladocera* are distasteful, and that the only other beetle known to be poisonous is allied to *Cladocera*, and inhabits the Kalahari Desert. Regarding the exact chemical nature of the poison investigators are still somewhat at variance. There is less dispute as to the effects of its experimental injection into various small mammals, but for details Pawlowsky's work (see below) should be consulted.

It is interesting to note that a serum, successful at least with rabbits, has been prepared. There is said also to be a natural antidote to N'gwa, viz. the "Kalahuetlwe," a bulbous or tuberous plant, with small, yellow, five-petalled flowers. The Bushmen, however, are very secretive about everything concerning this plant and its use.

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STAFF NEWS.

THE Principal Trustees have appointed Mr. Robert Bernard Benson, B.A., Assistant Keeper (Second Class) in the Department of Entomology. Mr. Benson was educated at Berkhamsted School and at St. Catherine's College, Cambridge. He graduated with *ægrotat* honours in the Natural Sciences Tripos, Part I, in 1925.

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Mr. F. W. H. Migeod has been appointed leader of the British Museum East Africa Expedition for the collecting season in 1929. He left England for Tendaguru, Tanganyika Territory, towards the end of March.

Natural History Magazine

No. 11

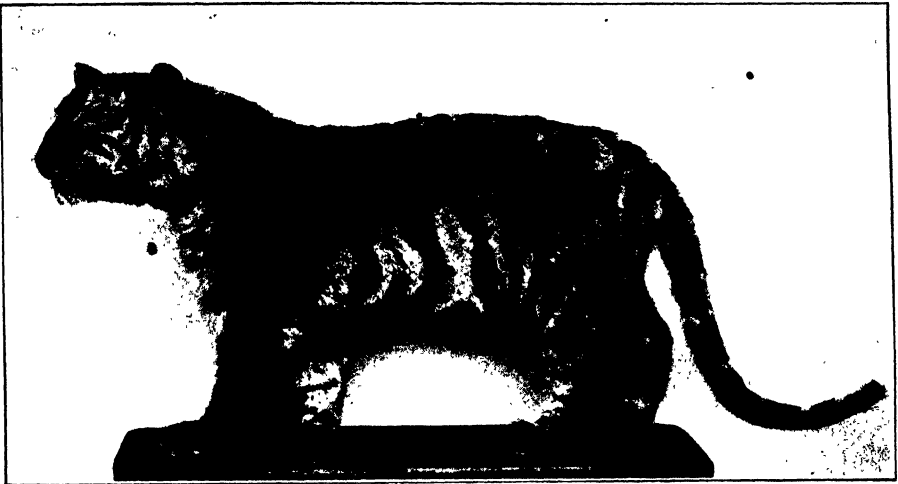
JULY, 1929

Vol. II

A YOUNG CHINESE TIGER.

By J. GUY DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

A MOUNTED specimen of a young Central Chinese tiger, which has recently been presented to the Museum by the Rowland Ward Trustees, will form a valuable addition to the exhibited



A YOUNG CHINESE TIGER.

series of the large carnivora. The specimen was mounted in the Rowland Ward Studios.

The typical tiger is the Bengal race, a long-limbed, rather lanky animal, with the coat uniformly short and richly coloured. Further north the winter coat gets longer and more shaggy; the Manchurian tiger (*Felis tigris longipilis*) having very long winter fur, with the stripes ill-defined and the general colour considerably paler than in the more southern races. The tiger of Central China may be regarded as intermediate between the long-haired, thick-coated Manchurian type and the sleeker, short-haired tigers of Bengal and the Indian Peninsula. The present specimen, which is an animal of a few months old, comes from the Hupeh Province of Central China. The Persian race

(*Felis tigris virgata*) has rather a deeper coloured coat, and the Javan tiger (*Felis tigris sondaica*) is both richer in colour and smaller in size.

The tiger enjoys a very extensive distribution, the range extending from the Caucasus, through Persia, India, Assam, Burma, the Malay Peninsula, Sumatra, Java, and northwards through China, Manchuria, and Korea. In India tigers are found over the greater part of the Peninsula, but are, curiously enough, absent from Ceylon.

A really big tiger will measure 10 feet 6 or 7 inches in total length, and many stand as much as 3 feet 10½ inches at the shoulder. It should be remembered that skins are easily stretched several inches during the skinning and dressing operations, and the only reliable dimensions are those taken while the animals are still in the flesh. For instance, a case is on record of a tiger that measured 10 feet 6 inches in the flesh, but was 11 feet 10 inches in length when skinned and dressed.

THE GREAT BARRIER REEF EXPEDITION, 1928-29.

By GEOFFREY TANDY, B.A., Assistant Keeper, Department of Botany.

ON May 26, 1928, there sailed from Tilbury the majority of the personnel of a marine biological expedition to the Great Barrier Reef of Australia. Under the leadership of Dr. C. M. Yonge we were bound for Brisbane and thence for Low Isles in lat. 16° 23' S., long. 145° 34' E., where it was expected that the expedition would make its headquarters for a full year's work on some of the many biological problems of coral reefs. None of us had any experience of life in the tropics, either as it concerned ourselves or the objects of our respective studies. It is perhaps not necessary to say that large numbers of mutually conflicting accounts were current and produced in us a certain, though not always unpleasant, trepidation. As happens so often, we found that the things we had anticipated with least confidence became least terrible in the light of experience.

The party arrived at its base on July 16th, and found preparations for its reception well advanced. Four huts had been built and the keepers of the light and their wives were expecting us. The island on which the lighthouse stands (Fig. 1) is a strange little sand-heap; its long axis is about 200 yards, and on it for the last nine months have lived some twenty-five people. The

conspicuous vegetation consists, as may be seen from the photograph, of about seven coconut palms and some pleasantly shady specimens of *Terminalia Catappa*. The lighthouse, with its white sides and red dome rising to sixty-five feet, is a notable and sometimes comforting feature of the seascape.

The work is divided among three parties: the Leader's party, the Boat party and the Shore party. The Leader is concerned with the feeding mechanisms and metabolism of the corals, and in this work he is assisted by his wife, who, among her other activities, is medical officer to the expedition. Mr. A. G. Nicholls is working on the life-history of the blacklip pearl oyster as well as helping Dr. Yonge in his work. Mr. G. W. Otter works at the



FIG. 1.—LOW ISLETS: WESTERN.

boring organisms which play such an important part in the reduction of coral masses to sand.

The Boat party, which began under the leadership of Mr. F. S. Russell, has all the hydrographic and plankton work within its scope. The most important aspect of this is the keeping of a weekly station about three miles east of Low Isles. Here are taken water samples and temperature records at five-metre intervals from top to bottom. Plankton fishing for recorded periods at depths measured by an Admiralty depth-recorder complete the work which is done afloat. In the laboratory a part of the water sample is centrifuged, and by suitable counting methods an assessment of the diatom and other phytoplankton population is made by Miss S. M. Marshall. Mr. A. P. Orr uses the rest for oxygen, phosphate and acidity estimations. Quantitative and qualitative analyses of the zooplankton are made by Mr. Russell. Since Mr. Russell left in December last his work has been continued by Mr. Colman.



FIG. 2.—PANORAMIC VIEW OF EASTERN ISLET FROM THE LIGHTHOUSE ON WESTERN ISLET.

The Shore party, under Dr. T. A. Stephenson, is concerned mainly with problems of growth and ecology. To this party I, as botanist, was attached. Naturally, therefore, the work of this party will bulk largely in what may follow.

The Low Isles (or Islets) were seen by Captain Cook on June 10, 1770, and his description of them has persisted as a name ever since. There are many islands conforming closely in plan to these and deserving the name equally well. From this latitude northwards and inside the reefs of the Outer Barrier, this arrangement of a wooded mangrove island on the eastward side and a sand cay on the westward side of a single reef or shoal is very common. Some idea may be gathered by comparing Figs. 1 and 2. The observer of the panoramic view (Fig. 2) is looking roughly south-east, the quarter from which the wind blows for about eight or nine months in the year. This "General Trade Wind," as Cook calls it, is a circumstance of obvious importance to all living things of the tide range and upwards.

But there are current so many inaccurate and strange ideas about the Great Barrier Reef that it may be well to try to set aside some of them at once. Cook says, "A reef such as one speaks of here is Scarcely known in Europe. It is a Wall of Coral Rock rising almost perpendicularly out of the unfathomable Ocean, always overflowed at high Water generally 7 or 8 feet, and dry in places at Low Water. The Large Waves of the Vast Ocean meeting with so sudden a resistance makes a most Terrible Surf, breaking Mountains high, especially as in our case, when the General Trade Wind blows directly upon it." This, of course, is very true so far as it goes, and particular attention is called to the fact that, normally, the reefs dry out at Low Water, Spring Tides only. And here let it be said that the expression "the Great Barrier Reef" is unlikely to produce the right image in the mind of one who does not know it. It is, without expressing any sort of opinion on the controversial aspects, a chain of reefs at the edge of a shelf varying in extension seawards from fifteen or sixteen miles to over one hundred at its southern end and having about thirty fathoms of water over it. The individual reefs are separated from one another by narrow and tortuous channels of roughly that depth. The chart northwards from Low Isles, inwards from the Barrier edge, shows a band of perhaps six miles with the inshore fringes of the reefs marked and the rest "Reported to be full of coral reefs."

Further (and here we may take up the work of the Expedition a little), many of these reefs are, in fact, vast flats of coral sand with fringes of living coral. The next photograph (Fig. 3) will

give some idea of this. This, actually, was a patch with a fair coral population near the landward edge of the reef (Batt Reef



FIG. 3.—SHORE PARTY AT WORK ON BARRIER REEF.

Left to right: Dr. T. A. Stephenson, Mr. F. W. Moorhouse, Mr. J. S. Colman, Mrs. Stephenson.

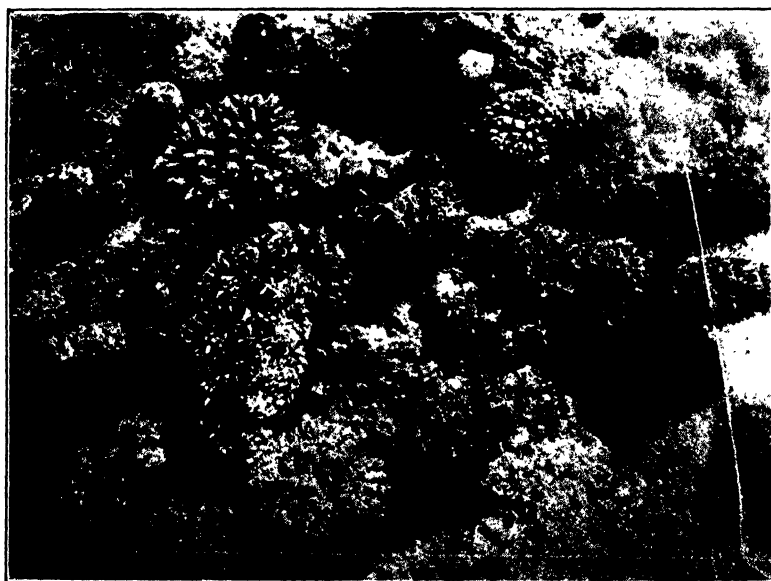


FIG. 4.—REEF-POLY VIEWED THROUGH THE WATER.

on the north side of Trinity opening), of which we saw most. The work in progress was a detailed ecological census and survey.

The area was about six feet square and was subdivided by strings which appear in this and the next picture (Fig. 4). This



FIG. 5.—ANGEL-FISH (*Holacanthus sexstriatus*).

section, in life, was a pleasant sight. The clam, which is at left-centre as one looks at the photograph, had a gorgeous mantle of darkest green blotched with bright orange, and its shell was covered with masses of bright blue compound Ascidians. Directly above it is a charming little coral (*Acropora* sp.); brown in the main but with terminal polyps of a delicate lavender. There are a number of other species of animals and plants in

this patch, but they are not very spectacular. The Angel-fish (Fig. 5) is notable. Dominantly, he seemed of a luminous dark blue, but his scales were edged with gold. He came into

our patch of reef as the tide flowed, as it invariably did before we had done the half of what we had set out to do. On this occasion we had to take refuge on a somewhat elevated patch and hope that the dinghy due



FIG. 6.—SHORE PARTY LEAVING THE REEF.

to take us back to the little yacht which had brought us from Low Isles would arrive before the sharks became unpleasantly inquisitive. Fortunately it did so (Fig. 6), though by that time there was too much water for us to move any further.

The romantic name of "Australia's Grand Canal," sometimes used of the seaway between the outer reefs and the mainland, is



FIG. 7.—MANGROVES (*Rhizophora mucronata*).



FIG. 8.—OLD MANGROVE INSIDE THE SWAMP.

apt to lead the imagination astray. True, the normal big swell of great oceans is broken by the barrier; but, in the vicinity of

Low Isles, the south-east Trade Wind has an unobstructed fetch of some forty miles, and that wind, when blowing at from twenty to thirty miles an hour, can raise all the sea that any small vessel needs to make her uncomfortable. Fortunately it is not necessary to go to the outer reefs for supplies of animals for experimental purposes. There is a bewildering variety at Low Isles, in species and in associations. The differences between these places are, in some respects, conspicuous, but, from the point of view of the experimental biologist, Low Isles serve admirably.

The shoal on which these two islets stand (for they are two for the mariner) has its long axis in the path of the Trade Wind. From the windward point there extends a more or less continuous rampart of dead coral or coral shingle. There is a gap on the leeward side, and here the rampart recurves on either side, leaving an anchorage, well sheltered from the prevailing winds but badly exposed to the north. In the western bight is the sand cay on which stand the lighthouse, the lightkeepers' houses, the laboratory and huts of the expedition.

The mangrove island is extremely interesting and fantastically unfamiliar to a visitor from higher northern latitudes. A dense forest of trees reaching sixty feet in height and of no mean girth grows on a shoal eight or nine miles off shore in sea-water of normal or slightly supernormal salinity. The trees maintain their upright position by the aid of large numbers of stilt-roots (Fig. 7), which in older specimens extend some distance from the tree (Fig. 8). Of special interest is the method of dispersal. The fruit germinates while still on the parent plant. A pointed radicle, which may be eighteen or more inches long, grows downwards. If there is no water under the tree when this seedling falls it behaves dart-fashion, plants itself in the mud and continues its growth without interruption. It may, if it fall in the water, be carried away by currents and then be left by the falling tide with the tip of the radicle in some crevice in the shingle or even in the concrete-hard conglomerate (Fig. 10).

The last two photographs (Figs. 11 and 12) represent beasts with a bad reputation. The Stone-fish is a genuine horror both in appearance and effects. He is repulsive-looking; of a dirty greenish-brown colour and very underhung. His danger lies in the row of spines on his back. These he can erect, and they contain a very deadly and, I believe, unknown poison. Moreover, they are strong enough to penetrate an ordinary plimsole. A pair of really strong boots is the best insurance against a painful and unduly protracted death; for such is the fate of



FIG. 9.—SEEDLINGS OF MANGROVE.



FIG. 10.—MANGROVE SEEDLING IN CORAL CONGLOMERATE.

most people who have made too close acquaintance with the Stone-fish.

The Giant Clam (the photographed scale is six inches long) is something of a fraud. It is said, there is no reason to think untruly, that walkers on reefs have put their feet into the shell and have been held until the incoming of the tide and consequent death by drowning. But the animal seems always anxious to close before anything approaches him and is, moreover, a plankton feeder. It would, I feel, be next to impossible to become trapped unless one were wading waist-deep, and even then it would be very bad luck.

Life on a tropical expedition nowadays can be made very comfortable for anybody who can stand a certain amount of humid heat. The usual daily maximum shade temperatures were 98° F. (dry bulb) and 78–80° (wet bulb).

The wet bulb was higher on one or two occasions, and then conditions were very uncomfortable. However, a refrigerator supplied ice twice a day; we had fresh meat once a week and an ample supply of fruit. There is an apposite passage in Captain Cook's Journal of his first voyage under

Wednesday, 26th March, 1771. He is at anchor, having lost many men from sickness, and another ship which has fared



FIG. 11.—STONE-FISH (*Synanceia horrida*).

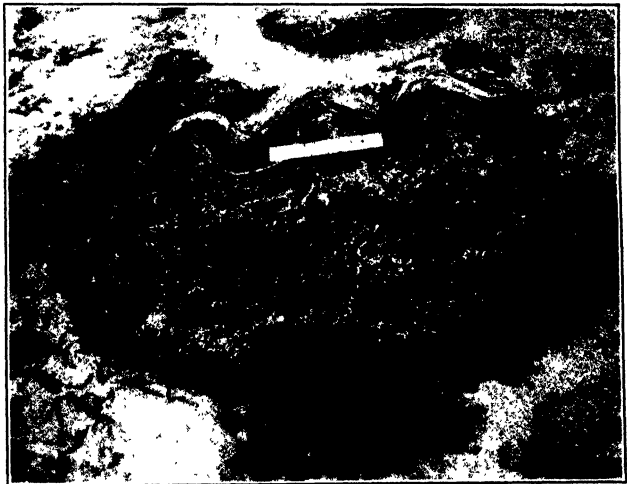


FIG. 12.—GIANT CLAM (*Tridacna* sp.).

worse has just gone. "Yet their sufferings will hardly, if at all, be mentioned or known in England; when, on the other hand, those of the *Endeavour*, because the Voyage is uncommon will very probably be mentioned in every News Paper, and, what is not unlikely, with many Additional hardships we never Experienced; for such are the dispositions of men in general in these Voyages that they are seldom content with the Hardships and Dangers which will naturally occur, but they must add others which hardly ever had existence but in their imaginations by magnifying the most Trifling accidents and circumstances to the greatest Hardships and unsurmountable dangers without the immediate interposition of Providence, as if the whole merit of the Voyage consisted in the Dangers and Hardships they underwent, or that real ones did not happen often enough to give the mind sufficient anxiety. Thus Posterity are taught to look upon these Voyages as hazardous to the highest degree."

SOME COMMENSAL MIDGES.

By F. W. EDWARDS, M.A., Assistant Keeper, Department of Entomology.

IN many different divisions of the animal kingdom there are to be found examples of symbiosis or commensalism, by which is meant the living together in close association of individuals of two (or more) quite unrelated species. When this association affords obvious advantages to both species concerned and the two are so well adapted to their joint existence that they are seldom found apart and may even be unable to live without each other's assistance, we speak of symbiosis; when the association is less intimate and one at least of the associates derives no special benefit therefrom, the term commensalism is used. Commensalism differs from parasitism in that the weaker member of the partnership does not feed at the expense of the stronger—it is not a sponger—but obtains its own food for itself while depending on its partner for some other benefits, such as shelter or protection from enemies. Perhaps the best-known example of such an association is that of the hermit crab, which carries a particular species of sea-anemone on the back of the whelk-shell in which it lives, while a particular species of worm inhabits the shell with the crab.

Among insects many examples of commensals are known, the most familiar being the various guests found in communities

of ants and termites, and, now that more attention is being devoted to the subject, a number of fresh instances of similar relations are being found to occur between insects of other groups. In this article it is proposed to notice some midges (Chironomid flies) which in the larval stage live in commensal association with other insects.

In 1923 Mr. A. L. Tonnoir described a small midge, the larvæ of which he had found in several widely-separated localities in New Zealand, living on the ventral surface of a larva belonging

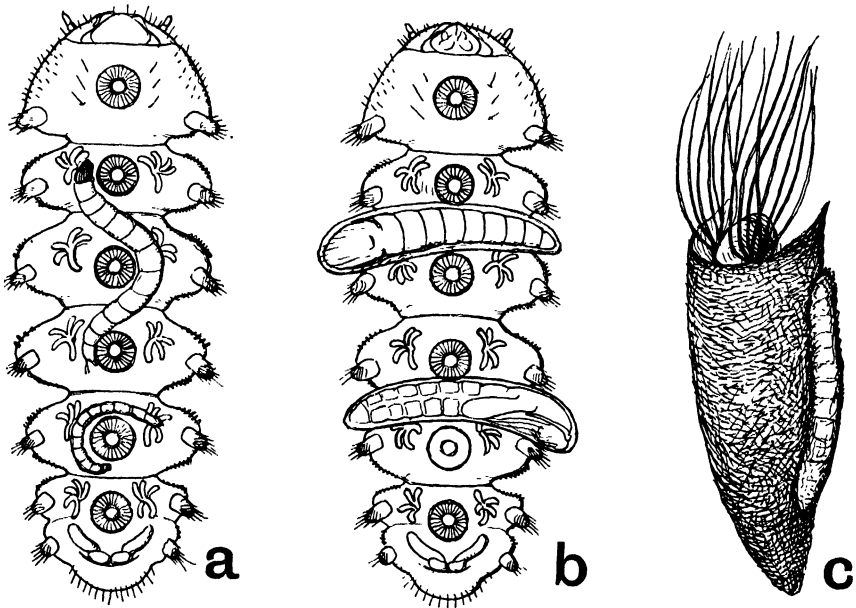


FIG. 1.—a and b, larva of *Neocurupira hudsoni*, Lamb, with larvæ (a) and pupæ (b) of *Dactylocladius commensalis*, Tonnoir, on its ventral surface (after Tonnoir); c, cocoon of *Simulium ornatum*, Mg., with cocoon of midge (*Eukiefferiella* sp.) beside it.

to the Dipterous family Blepharoceridæ. The larvæ of this latter family always live on rocks in rapid streams, attaching themselves by means of a row of six suckers, between and around which the tiny midge larvæ make themselves at home, evidently with the object of finding shelter from the current (Fig. 1, a). According to Mr. Tonnoir, the whole of the larval and pupal stages of the midge are spent in this position, though he did not ascertain how the young larva reaches its protector. When the midge larva is full-grown, it comes to lie transversely between two suckers, and secretes a mass of jelly, in which it changes to a pupa. The gelatinous coating fixes the pupa firmly to the Blepharocerid larva, and shortly after its formation the pupa

turns within its sheath so that it faces upwards, that is, towards the ventral surface of the large larva (as shown in the upper of the two midge pupæ in Fig. 2, *b*). In this position the pupa remains until the adult midge is ready to emerge. A remarkable fact about this association is that the midge is strictly confined to one species of host (*Neocurupira hudsoni*), although other species of Blepharoceridæ occur in the same localities. Mr. Tonnoir considers that this selection is due to the comparatively large size of the larva of *Neocurupira hudsoni*, which therefore offers a more efficient shelter; but he also finds that *Neocurupira hudsoni* is slower in its development than the other Blepharoceridæ, a fact of no little importance to the midge, which must of necessity attain to the adult stage before its host larva changes to a pupa.

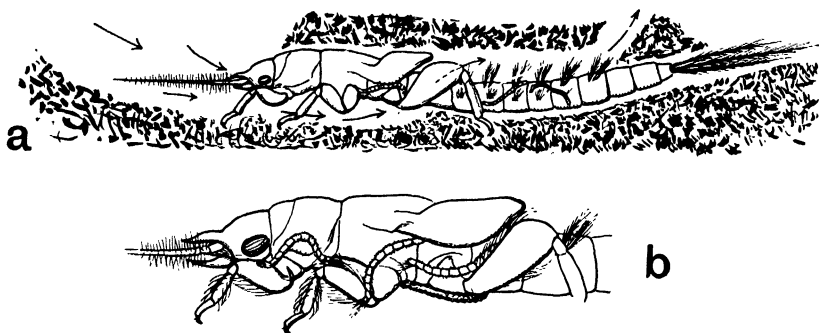


FIG. 2.—Nymph of *Ephemera vulgata*, L., with larvæ and (on enlarged figure *b*) a cocoon of the midge *Camptocladius ephemere*, Kieff (after Šulc and Zavřel).

In 1924, that is, during the year following the publication of Mr. Tonnoir's discovery, Mr. K. Šulc and Prof. Zavřel issued an account of another remarkable commensal midge larva, found by them in Czechoslovakia, living on the nymphs of the large may-fly (*Ephemera vulgata*). This nymph has the unusual habit (for a may-fly) of forming a burrow in the mud at the bottom of a stream, remaining more or less stationary, and, by the vibration of its appendages, causing a current to pass through the burrow (Fig. 2, *a*). Organic particles and minute animals are drawn in with the current, and the larger organisms form the food of the may-fly nymph, being caught in a sort of filter composed of erect hairs on the nymph's antennæ and front legs. Smaller particles pass through this filter and provide food for the midge larvæ (Fig. 2, *b*) which live in the burrow and may very probably perform a useful service for the nymph by keeping its gills clean. The authors do not state whether the midge

larvæ are ever eaten by the may-fly, but presumably they are sufficiently active to escape its jaws; they pupate in a loose cocoon attached to the body of the nymph. The association of these two species of insects is evidently very definite, because the same midge has since been found living with the same may-fly in Yorkshire, a student of Leeds University having independently discovered the connexion between them. Any possible doubt as to the identity of the midge has been removed by the comparison of material sent to the British Museum by Prof. J. Zavřel of Brno and Mr. E. Percival of Leeds. The adult midge has also been met with in Cheshire by Mr. H. Britten in a locality where may-flies (*Ephemera danica*) were abundant.

In both the instances noticed above the habits of the midge larva appear to be definitely fixed, and the larva has never been found except in association with its host. There are, however, some cases of what may be termed facultative commensalism, in which the midge larva, though frequently found in association with another insect, can also live independently. Two examples of this have come to my notice, in both of which the midge larva inhabits the cocoons of "black-flies" (*Simulium*). When studying the biology of British *Simulium* in 1916-20 I frequently found that the cocoons of *S. ornatum*—a species which is very common on water plants in small rivers with a moderate current—included a tiny, active, midge larva; very often the pupa of this midge (a small *Eukiefferiella*) was found in a slight cocoon lying close beside the cocoon of the *Simulium* (Fig. 1, c). I was unable to investigate the exact nature of this association, but further light has now been thrown upon the matter by Mr. H. J. Falkner, of Torquay, who has found midge larvæ in the cocoons of *Simulium latipes* and *S. aureum*. Regarding these larvæ Mr. Falkner writes (February 27 and March 7, 1929):

"Did I tell you of the strange little midge whose larval and pupal stages seem to be passed entirely in the pupal sheath of the Simuliidæ? It behaves just like the worm at the end of the whelk shell inhabited by the hermit crab. That is, it does not leave the sheath, but stretches forward to feed—and apparently lives the whole time and pupates in the same sheath, as there accumulates quite a lot of detritus with the cast larval skins in the very bottom of the sheath. I found them difficult to rear, as the midge larval stage is passed during the *Simulium* pupal stage, then on the exodus of the *Simulium* fly the midge pupates; this means that, when I collected the *Simulium* pupæ to rear, the larval midges died, and it was only by collecting empty *Simulium* pupal sheaths with midge pupæ inside that I managed

to get out five or six as flies. . . . I have an idea that it is the same minute larva that is found on water-cress growing in swift streams, and the one that normally pupates in the shelter of the junction of stem and leaf, and that my case is one of facultative or adaptive commensalism brought about by the total absence of shelter except in the cocoons—which were all taken from stones at or near the edge of fast streams.”

Mr. Falkner's suggestion as to the identity of the midge larvæ is probably well founded. Specimens submitted by him proved on examination to belong to the species described by Goetghebuer as *Cricotopus dispar*, the larvæ of which I have found in abundance (in the absence of *Simulium*) on submerged leaves of such plants as water-cress and *Sium*. Nevertheless, the occurrence of these larvæ in *Simulium* cocoons seems to be more than accidental. A point worth noting is that all four of the midge larvæ referred to in the above notes belong to the same group of the family Chironomidæ. To this group belong also certain peculiar larvæ which have become definitely parasitic on may-fly nymphs, thus completing the transition from independent life to parasitism, the intermediate stages being exemplified by the larvæ described above. It may confidently be anticipated that further study of this group of midges will reveal the existence of other species with equally interesting habits.

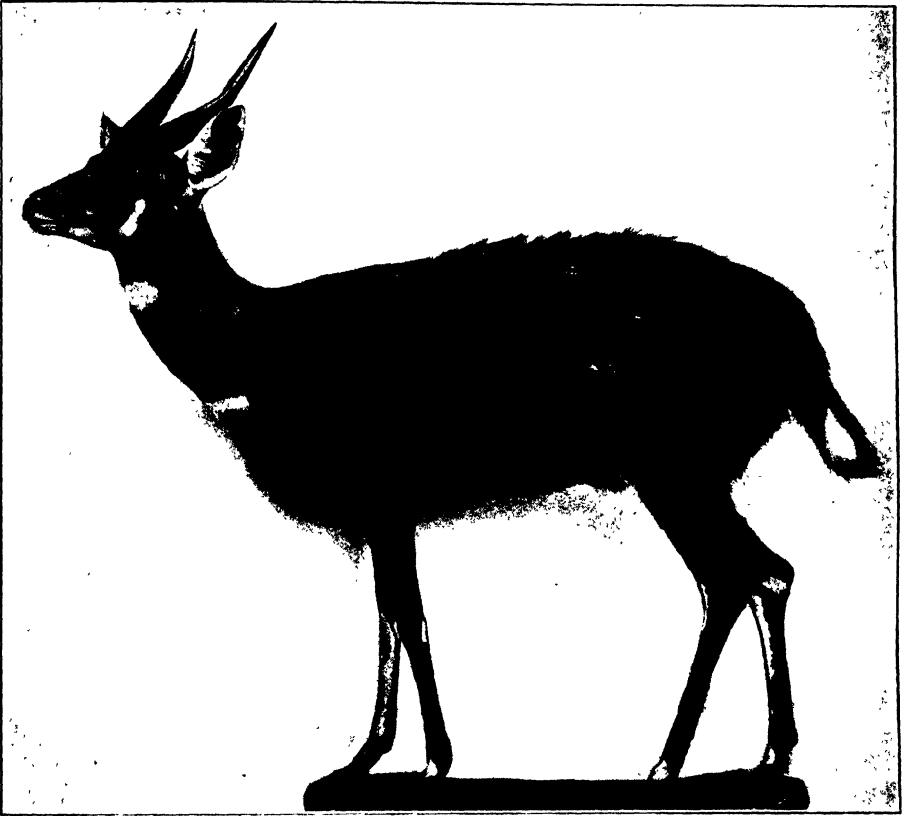
BARKER'S BUSHBUCK.

By J. GUY DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

BUSHBUCKS are the typical members of a subfamily of antelopes known as the *Tragelaphinæ*; the group also includes the elands, kudus, bongos, the Indian nilgai, and four-horned antelope. These antelopes are large or medium in size and, with the exception of the elands and bongos, horns are found only in the male sex; the horns are spirally twisted, keeled anteriorly, and without the well-marked transverse ridges met with in the nearly allied groups. In most of these antelopes the body is marked with vertical white stripes, or white spots, and there is frequently a white chevron on the forehead.

All the bushbucks are included in the single genus *Tragelaphus*; it is probable, however, that the nyala (*T. angasi*) and the mountain bushbuck (*T. buxtoni*) will have to be considered as representing distinct genera. The true bushbucks, or

harnessed antelopes, usually exhibit considerable sexual differences in the colour of the coat, the females being more brightly coloured and having more distinct body markings; the males are as a rule darker and more uniform in colour. The various forms, about thirty in number, may be considered as races of a single species, *Tragelaphus scriptus*, the typical *T. scriptus*



BARKER'S BUSHBUCK.

coming from Senegal in West Africa; the several subspecies are widely distributed over the greater part of Africa south of the Sahara from the Sudan and French West Africa to Cape Colony.

In many bushbucks the hair round the lower part of the neck is quite short, looking as if the animal had worn a collar; in others the hair on the neck is normal. It is a matter of considerable doubt if this character can be regarded as of systematic

importance; it may be simply an individual feature, perhaps connected with age or seasonal change of coat. This collar-like effect is well illustrated in the accompanying photograph of Barker's bushbuck.

The males usually have a crest of long, white, erectile hairs down the middle of the back; in some cases this crest is black, as it is almost without exception in the female sex. These animals range from about 28 to 30 inches in height and weigh from 100 to 170 lb. The horns are never of very great size, the smaller horned races rarely exceeding 11 to 15 inches in length, and the greatest horn lengths on record are $21\frac{3}{8}$ inches (*Tragelaphus s. barkeri*) and $21\frac{1}{4}$ inches (*T. s. sylvaticus*). In colour most bushbucks show little variation, all being very much the same. The general tint of the upper parts is usually some shade of chestnut or brown, and when the white body markings are well developed they comprise two longitudinal bands on each side, a series of vertical stripes, and a number of spots on the shoulders and hind-quarters. There are usually white spots on the face below each eye and on the nose, and a white chevron is generally present on the throat and another band on the chest. As already remarked, these harness-like markings are best developed in the female, the males being frequently more soberly clad.

The most distinct of the numerous races are the following :—The typical bushbuck (*T. s. scriptus*) from Senegal and other parts of West Africa is one of the smallest of the whole group, standing only 28 inches at the shoulder and carrying horns from 11 to $13\frac{1}{4}$ inches in length. The white body markings are well developed and the general colour deep chestnut. The males have blackish underparts and the females are paler throughout. Specimens of this race have been recorded from Senegambia, Sierra Leone, Liberia, and Ashanti. In the Cameroons we find a somewhat similar animal, *T. s. knutsoni*, in which the dorsal crest is black and the hair on the neck is normal; in the typical bushbuck a short-haired collar is developed in the old males. A pale yellowish-coloured race, *T. s. decula*, hails from Abyssinia; it agrees with the Cameroon bushbuck in having a black dorsal crest and normally haired neck. As a rule the vertical stripes are absent in this form: Closely allied is the rare Barker's bushbuck which is here illustrated (*Tragelaphus s. barkeri*), popularly known as the "Giant Bushbuck," though why it should have been so christened is a little difficult to understand, since the bodily size is no greater than in several other races. The horns are, however, unusually well developed, and measure-

ments of 18 inches and over are by no means rare; there are two specimens on record which measure 20 inches in length, and the biggest horns at present known are the $21\frac{3}{8}$ -inch horns in the possession of Sir George Abercromby, Bart. As will be seen from the photograph, the white markings are but little developed in the adult male; in the females, however, the body is rather more fully marked. This large-horned bushbuck is known only from the Imatong Mountains of Mongalla in the Sudan. The specimen, the photograph of which is here reproduced, was shot and presented by Mr. R. Akroyd; it has been modelled in the Rowland Ward Studios.

Another large race is Menelik's bushbuck from Arussi, Gallaland; this animal stands about $29\frac{1}{2}$ inches at the shoulder, and the coat is of considerable length. In colour the males are dark brown or black, and the white markings are reduced to a few rather indistinct spots on the hind-quarters; the female is more rufous in colour. The neck is normal, there being no trace of a short-haired collar in the specimens in the Museum collection. Closely allied to *T. s. meneliki* is the Abyssinian *T. s. multicolor*, in which the crest along the back is black and a short-haired collar is developed; the white flank markings are here again reduced and are represented only by a few white spots on the hind-quarters. The type locality of this bushbuck is the Hawash Valley, Shoa, Abyssinia.

In the White Nile district of the Bahr-el-Ghazal we meet with a very handsomely marked race known as the Bor bushbuck (*T. s. bor*), Bor being the locality where the animal was first described from. The neck is fully haired and the dorsal crest black; the body is pale brownish and has from three to five white vertical stripes on the flanks. The upper longitudinal flank band is indistinct or entirely absent; the lower one is very incomplete. In the females the markings are more fully developed, there being as many as nine or ten vertical stripes on the flanks. *T. s. pictus* is a still more conspicuous form from the Lower Shari Valley, near Lake Chad, Northern Nigeria; the general colour is brighter and the white markings more distinct. Lord Delamere's bushbuck (*T. s. delamerei*) is a large, richly coloured race from the Sayer Valley of Kenya Colony; in this animal the flank stripes are very ill-defined and the general body colour brownish buff. The Masai bushbuck (*T. s. massaicus*) is a closely allied form, paler in colour and with more distinct white markings. The Chobi bushbuck (*T. s. ornatus*) is a rather smaller animal, being about equal in size to the typical *scriptus*; it is very brightly coloured and well marked,

having from six to eight white stripes on each side of the body and a short-haired collar. This antelope is found in the Chobi Swamp, south of the Zambesi, in Northern Bechuanaland. Further south the white markings tend to disappear; *T. s. rousalenyi*, from the source of the Limpopo, being a dark-coloured race with very indistinct markings in the adult pelage. In Cape Colony there is a large-horned, dark-coloured bushbuck, *T. s. sylvaticus*, in which the longitudinal and vertical striping is absent, there being only a few white spots on the shoulders and hind-quarters. The horns of this race are considerably larger than in the allied forms, horns of over 17 inches in length not being uncommon; the hair of the neck is similar to that of the Chobi bushbuck. The distributional range of this Cape bushbuck extends from Cape Colony northwards through the Transvaal and Natal into Portuguese East Africa; possibly specimens from Nyasaland may represent this race.

The nyala (*T. angasi*) is a very handsome antelope, and considerably larger than the true bushbucks, standing about 42 inches at the shoulder and weighing as much as 250 to 300 lb. The horns are also much larger and heavier, the longest pair on record (in the British Museum collection) measuring nearly 33 inches in length, that is, exceeding by 10 inches the longest known bushbuck horns. The sexes differ widely in colour, the adult males having a long, shaggy coat of coarse, greyish-brown hair, indistinctly marked with white, vertical stripes; the females are, however, bright chestnut-red in colour, with 13 or 14 well-defined stripes on the sides of the body. The nyala is restricted to South-East Africa, the range extending from Natal to Nyasaland and Lake Mweru; it was originally discovered by Mr. Douglas Angas, near St. Lucia Bay.

The mountain bushbuck is a still larger species which was described as recently as the year 1911. It was first discovered in the Sahatu Mountains of Gallaland by Mr. Ivor Buxton, and named *Tragelaphus buxtoni* by the late Richard Lydekker. The bodily size is very much greater than in any other bushbucks, adult specimens standing some 53 inches in height at the shoulder, and thus more resembling a kudu in stature than a bushbuck. The horns are also very much larger and more massive, measuring, in the record specimen, 42 inches in length and 10 inches in circumference; the horns form a more open spiral and diverge more outwardly than in the nyala or bushbuck. The sexes are similar in colour; the general tint is a brownish fawn and the white body markings are represented by a series of rather indistinct spots; the face is marked in the usual

tragelaphine style, and further white patches occur on the throat and chest. This fine antelope is known only from the Sahatu Mountains of north-west Gallaland.

Until quite recently the situtunga has been classified as a member of the genus *Tragelaphus*; owing, however, to the great elongation of its hoof it is now regarded as representing a distinct genus, *Limnotragus*. As indicated above, it may be necessary to do likewise with the nyala and mountain bushbuck, two animals which are really quite as far removed from the true bushbucks as is the situtunga. The latter species is widely distributed and, as might be expected, divisible into local races. The range extends over a large part of West Africa, from Senegambia to Nigeria and Gaboon, and through the Congo eastward to Uganda and the Bahr-el-Ghazal; southward it occurs in Nyasaland, the Kafue, Zambesi, and Chobi Valleys to Angola.

The typical situtunga (*L. spekei*) is the Uganda race from the Victoria Nyanza; in this form the male is greyish-brown without stripes, and the female rufous with faintly defined stripes. This race extends northwards into the Bahr-el-Ghazal and westwards to Ruwenzori. In the closely allied Zambesi situtunga (*L. s. selousi*) the females are coloured like the males, both sexes being greyish-brown; this form extends from Angola and Lake Ngami northwards to the Zambesi, Northern Rhodesia and Nyasaland. In the Western situtunga (*L. s. gratus*) the sexes are coloured as in the typical race, but are both marked with numerous white spots.

The great elongation of the hoofs of this antelope is apparently a special adaptation to enable the animal to travel with ease over the soft mud and reed-beds of the swamps and marshes which it inhabits. It is interesting to note that the foetal markings of this species are quite as well developed as in the most "harnessed" of the bushbucks, the white markings gradually disappearing during the post-natal period.

CONVERGENCE IN POLYZOA: A NEW EXHIBIT IN THE STARFISH GALLERY.

By ANNA B. HASTINGS, B.A., Assistant Keeper, Department of Zoology.

ANYONE who has examined a piece of seaweed (*Fucus*) from the rocks between tide-marks has probably seen some Polyzoa on it. Few, however, guess that they are looking at animals. The Polyzoan may be a branched tuft about an inch high, and

the observer probably thinks that it is another kind of weed; or perhaps, seeing a thin, lace-like incrustation, he never suspects

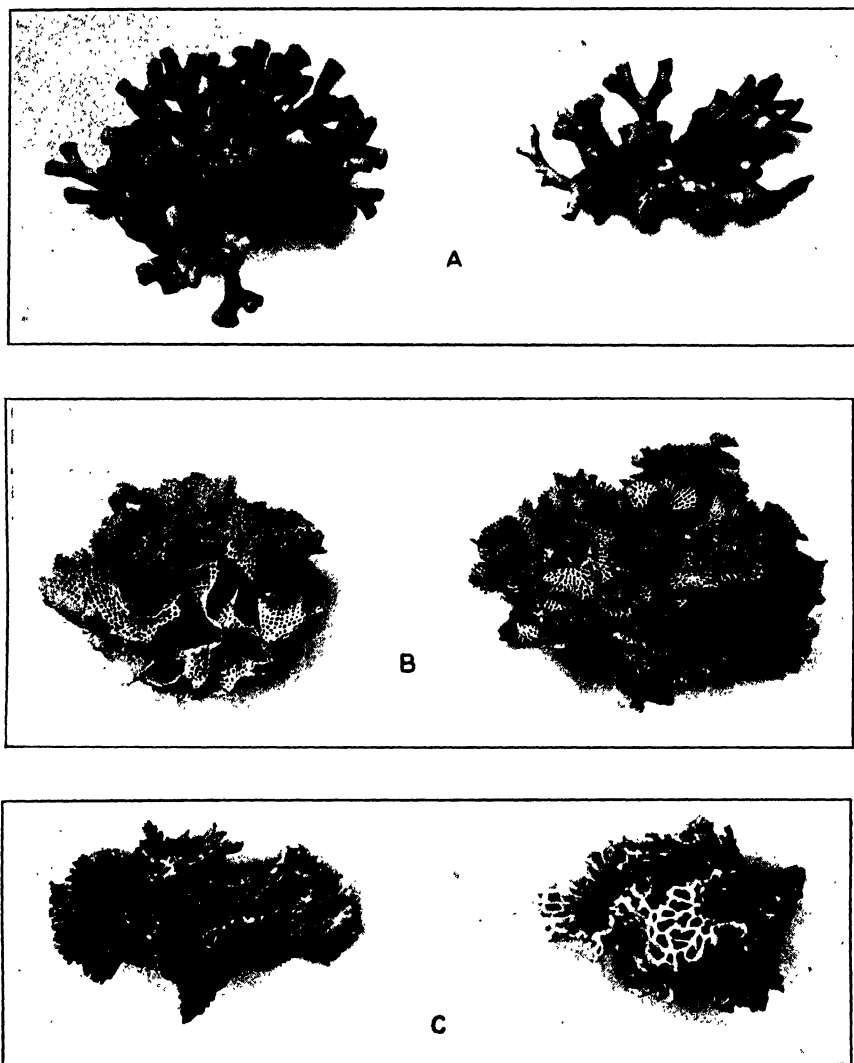


FIG. 1.

CHEILOSTOMATA.

- A. *Myrionozoum truncatum*.
 B. *Retepora monilifera*.
 C. *Retepora crassa*.

CYCLOSTOMATA.

- Heteropora pelliculata*.
Hornera foliacea.
Frondipora verrucosa.

that it is alive at all. But these, and many other growths of varied shape and form, are colonies of minute animals. In this the Polyzoa resemble corals, and some of them really look like

corals. But the little animals of which they are composed are completely different, and here we have our first example of

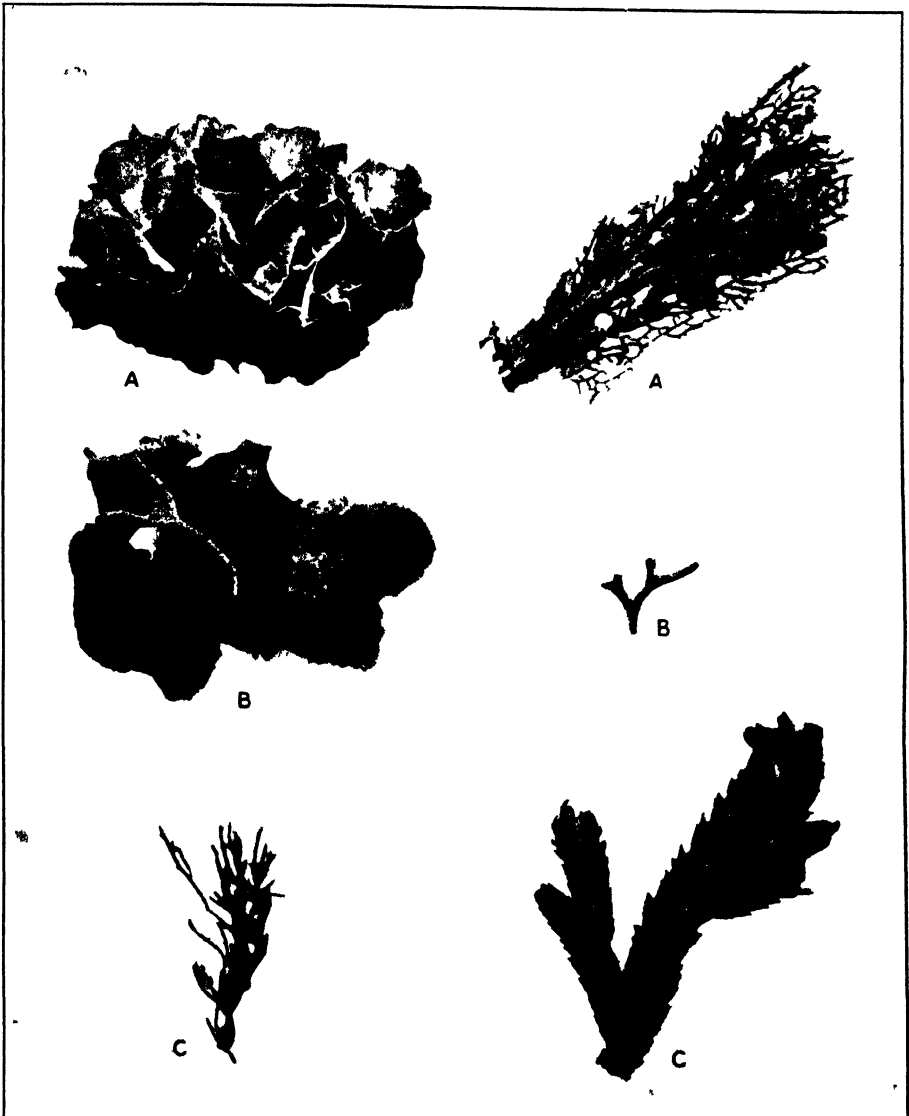


FIG. 2.

A. *Membranipora savartii*. B. *Steganoporella magnilabris*. C. *Electra pilosa*.

convergence, or the superficial resemblance of unrelated or distantly related animals.

The Polyzoa are classified in five groups which differ markedly in the form and structure of the individual animals, in their

larvæ, and in the methods by which their young are protected and nourished. In two of these groups the body-wall is calcareous and the colony is consequently more or less stony. These two groups are called the Cyclostomata and the Cheilostomata, and each shows a great diversity of colonial form. On the other hand, it is not uncommon for two colonies to be very similar in appearance though one belongs to the Cyclostomata and the other to the Cheilostomata. Fig. 1 illustrates this convergence. In the first pair the colony consists of smooth cylindrical branches, rounded and a little swollen at the tips. The colonies of the second pair are regularly perforated throughout and are elaborately convoluted. The members of the third pair are also pierced by numerous holes, but their whole appearance is coarser and more shrubby.

The converse is also true, and colonies composed of exactly similar animals may be widely different in appearance. Fig. 2 shows three pairs of colonies. The members of each pair are quite unlike each other though they are built of indistinguishable animals. In the first species one colony stands erect and consists of thin, folded, contorted sheets; the other is a thin encrustation on another animal. One specimen of the second species is also erect and foliaceous; the second, likewise erect, is branched and twig-like. Both specimens of the third species are thin crusts, but their appearance is different because they have moulded themselves to the kinds of seaweed on which they are growing.

Occasionally the causes of these resemblances and differences are known, as in the last example. Often we can only guess that the form into which a young colony will grow may be settled by such conditions as the space available, the currents in the water, the presence or absence of sand, etc. In some cases of convergence, e.g. *Retepora* and *Hornera*, the form is so characteristic of the species that it seems not to be influenced by the conditions under which the individual colony lives. This leads us to questions, as difficult as they are interesting, of the laws that have governed the evolution of the species, questions too big and too general for discussion here.

RECENT IMPORTANT ACQUISITIONS.

Department of Zoology.

A FINE series of birds from the Gambia; collected by Mr. Willoughby P. Lowe and presented by the Percy Sladen Trustees. The collection comprises 546 skins, and includes specimens representing three species of vultures. Six

specimens of Temminck's Guereza, a species of monkey hitherto poorly represented in the Museum collections, are included in a small collection of mammals made by Mr. Lowe at the same time.

A specimen of a young Chinese Tiger; the head of a South African Giraffe from Matabeliland; presented by the Rowland Ward Trustees.

Specimens of six breeds of domesticated fur rabbits; presented by Mr. E. Bostock Smith.

A copy of "Birds of Australia" (14 quarto volumes containing 600 coloured plates); presented by the author, Mr. G. M. Mathews.

The skull of an African Buffalo (*Syncerus caffer*) carrying horns of exceptional size, the specimen ranking second in the list of records and possessing by far the largest horns in the Museum collection; presented by Mrs. C. M. L. Holmes. The animal was shot on the Tanganyika-Kenya border by the late Reginald Trayton Holmes, Croix de Guerre.

Fifty-nine mammals and one bird collected by Mr. Shaw-Mayer in New Guinea; presented by Mr. J. Spedan Lewis. The collection contains one new Opossum (*Phascogale* sp.) and a new *Pseudochirus* from the Arfak Mountains of Dutch New Guinea. There are also some interesting fruit-bats, including two specimens of the tubular-nosed bats *Nyctimene celano*, and a specimen of one of the pollen-eating bats of the genus *Macroglossus*.

A series of eleven enlargements of the photographs of East African game animals taken by Colonel Marcuswell Maxwell and recently published in *The Times*; presented by the proprietors of that journal. It is proposed to exhibit these photographs on the pillars of the Lower Mammal Corridor.

The herpetological collections of the late Dr. J. de Bedriaga, and a selection of books and pamphlets from his library; presented by Dr. G. A. Boulenger, F.R.S. This collection of reptiles and amphibians (1,306 specimens) contains typical material which has been described by almost all the better known European herpetologists, and is especially rich in representatives of the numerous races of the Wall Lizard from the islands of the western Mediterranean. The books and pamphlets, 159 in number, are almost all works or editions new to the zoological library of the Museum.

Department of Entomology.

A set of specimens of the first brood of the imported Dutch form of the Large Copper butterfly; presented by Captain E. B. Purefoy on behalf of the Committee for the Protection of British Butterflies.

Specimens of a new species of tsetse-fly from the Belgian Congo; presented by Dr. J. Schwetz.

Examples of a new genus and species of Hymenoptera (Ichneumonidae) parasitic on the Bushman's Arrow-poison Beetle, from South Africa; presented by Mr. P. A. Buxton.

A collection of 13,946 insects of various orders (including a consignment previously announced); presented by Mr. R. E. Turner, who collected them in South and South-west Africa during 1928. Upwards of 6000 of these specimens belong to the Hymenoptera, and some 4000 are Coleoptera.

A collection of about 40,000 insects of various orders; collected and presented by Dr. Hugh Scott and Mr. J. Omer Cooper, who obtained the specimens during their expedition to Abyssinia in 1926-27. Among those already prepared for study, nearly 16,500 are terrestrial, and some 15,000 represent aquatic species; although a detailed study will occupy some years, certain small groups already worked out show a high percentage of species new to science.

A valuable collection of Lepidoptera made by the late Mr. A. E. Wileman

during his thirty years' consular service in Japan, Formosa, and the Philippine Islands; presented by Mrs. Wileman in memory of her husband. The collection which consists mainly of moths, is in excellent condition and comprises some 25,000 specimens, including nearly 760 types.

Nearly 1000 insects of various orders from Malekua; collected and presented by Miss L. E. Cheesman, who is engaged in entomological research in the New Hebrides.

About 2000 Devonshire insects, including several rare sawflies new to the Museum collections, and extensive series of rare Odonata, Trichoptera, Neuroptera, Plecoptera, and Ephemeroptera; presented by Dr. R. C. L. Perkins, F.R.S.

A series of dried larvæ of a Saturniid moth, *Coloradia pandora*, Blake, from the Mono Lake district, California; presented by Dr. J. M. Aldrich, of the United States National Museum. The caterpillars of this moth feed on the needles of a species of pine (*Pinus jeffreyi*) at an altitude of some 7000 feet, and are collected, dried and used as food by the local Indians. The life-cycle of the insect occupies two years, and, as an indication of the numbers in which the caterpillars sometimes occur, an Indian chief is said to have prepared a ton and a half of these larvæ during a single summer.

Department of Geology.

The skeleton of a large *Ichthyosaurus* more than thirty feet long; presented by the Portland Cement Company.

The skeleton of the horse-like mammal *Moropus*; purchased. This animal is one of the Chalicotheres, distantly related to the Horses, and hitherto the Museum has only some incomplete remains from India and a single claw from Central Africa. The individual now acquired came from the Middle Tertiary of North America; it stands as high as a large horse, but the bones are far more massive.

Cretaceous invertebrate fossils from Lincolnshire; the cast of the lower jaw of an ape from the Oligocene of Bavaria; invertebrates from the Portland Sands of Dorset; type-specimens of Carboniferous and Devonian corals; the cast of the skull of the Triassic turtle *Proganochelys* from Germany; snake remains from the lower Tertiaries of Ecuador; the pelvis of a young Moa from the Holocene of New Zealand; purchased.

Carboniferous corals, brachiopods and molluscs from Yorkshire and South Wales; Liassic brachiopods and molluscs from Dorset and Somerset; Gault cephalopods from Folkestone; Eocene wood, foraminifers and molluscs; Miocene fish-teeth; Pleistocene lamellibranch molluscs; Permo-Carboniferous plants; Carboniferous sponges from Yorkshire; graptolites from the Ordovician of Shropshire; Silurian corals from Pembrokeshire, Shropshire, Belgium and Sweden; British Liassic and Cretaceous cephalopods; Miocene ants from Colorado; a fish from the Cretaceous of Herzegovina; and an imperfect Hippopotamus skull from Brondesbury.

Department of Mineralogy.

Gem-minerals from Brazil, including topaz, beryl, and garnet; presented by Mr. N. Medawar.

A fine crystal of green tourmaline from Brazil; presented by Mr. F. N. Ashcroft.

Crystallized sprays of native gold in calcite from Torquay; discovered and presented by Professor W. T. Gordon.

A group of calcite crystals showing a curious curvature from Italy; a series of 670 specimens of igneous rocks from Thuringia; purchased.

Rough and faceted specimens of olivine of gem quality recently discovered in western Norway; presented by Professor V. M. Goldschmidt, of Oslo.

A further selection of over 1000 mineral specimens, representing more than a hundred Swiss localities; presented by Mr. F. N. Ashcroft. With his previous donations of Swiss minerals, and those bequeathed by the Rev. J. M. Gordon in 1922, the Museum now possesses the finest collection extant for illustrating the conditions of mineral growths in the special type of Alpine veins. Mr. Ashcroft has also made a further addition to the large series of beautifully crystallized minerals of the zeolite group with which he has enriched the Museum collection during some years past.

A collection of polished slabs of ornamental marbles labelled with their trade names and countries of origin; presented by Messrs. J. Lyons & Co., Ltd.

A beautifully marked septarian nodule from the Coal Measures of the Rhondda Valley, Glamorganshire; presented by Mr. A. S. Hodgson.

A piece of a new meteoric iron from Brazil; presented by Mr. N. Medawar.

A rich gold specimen showing films of petzite (telluride of gold) and native gold along cleavage cracks in ankerite; presented by the President and Directors of the Hollinger Consolidated Gold Mines, Ltd.

Well-crystallized specimens of the borate minerals from California; purchased.

Crystal groups of native copper from the Lake Superior (Michigan) copper mines; purchased.

A large (19½ lb.) crystal of rhodonite from Franklin Furnace, New Jersey; purchased.

A plaster cast of a 14-cwt. mass of meteoric iron recently found in Queensland; purchased.

Department of Botany.

228 Norwegian plants; acquired by exchange from the Botanical Museum, Oslo.

A collection of Jamaican mosses; acquired by exchange from the United States National Museum, Washington.

A large number of specimens illustrating the marine flora of the Great Barrier Reef (Australia) and adjacent areas; brought back by Mr. G. Tandy, of the Department of Botany, who spent five months with the Great Barrier Reef Expedition.

Mr. D. A. Jones's Herbarium of 3300 specimens of British Mosses and Liverworts; purchased.

1260 specimens of Spanish plants collected by Frère Sennen; purchased.

438 specimens of Moroccan plants collected by Dr. P. Font Quer; purchased.

BOOK NOTICES.

Ants, Bees, and Wasps: a Record of Observations on the Habits of the Social Hymenoptera. By SIR JOHN LUBBOCK (Lord Avebury), F.R.S., D.C.L., etc. New edition based on Seventeenth, edited and annotated by J. C. MYERS, Sc.D., F.E.S., with four Coloured Plates by A. J. E. Terzi. Pp. xix + 377. 1929. (London: Kegan Paul, Trench, Trübner & Co., Ltd.; New York: E. P. Dutton & Co., Incorporated. 10s. 6d.)

In the Editor's Foreword it is pointed out that no fewer than seventeen editions have been issued since 1882, proving the popularity of this classical

work, and that we now know much more about these insects and their marvellous social organization than Lubbock knew. The present edition is intended as an introduction to the more comprehensive works of Wheeler, Forel, and Donisthorpe. The plan of the new book is essentially simple—Lubbock's text without appendices, but followed by one consecutive series of annotations and a short working bibliography.

The chapter entitled "Lubbock as an Entomologist and Comparative Psychologist" will bear careful reading as a fair statement, though only affording a passing glance, of a part of the life of a great man. A good account is given of many of his discoveries and researches, and his points of view of animal behaviour and so forth are duly explained. Dr. Myers justly remarks :— "It is probable that the animal psychologist of the future will find less to criticize in Lubbock's conception of insect behaviour than in that of many of his successors, who deal in such dubious notions as 'reversed behaviour' and 'forced movements.' Even his anti-Bergsonian heresy that the 'mental powers' of ants 'differ from those of men not so much in kind as in degree' probably hardly deserves the criticism given it. . . ." It is also truly stated that "One of the most remarkable features of Lubbock's works is their extraordinary popularity," and that "It is probably true that more than half the pleasure of research with him lay in communicating the results to others."

Four of the plates are new, and have been specially painted for the work by Mr. A. J. E. Terzi to replace Lubbock's coloured plates. The other two plates consist of diagrams of ants' nests, which appeared in the original edition. It is, of course, true that as regards drawing, details, and execution the new plates are superior to the old, although we think that the colours of the latter are more true to life, especially in the case of *Formica rufa*, *Formica sanguinea*, and *Lasius flavus*.

After the original text we come to the annotations. These consist of 59 Notes that deal with the more important points which have been elucidated in recent years, or on which Lubbock's results have been either corroborated or refuted. Space will not allow us to touch on more than a few of them.

Note 1.—Modern psychology cannot admit Lubbock's claim that ants rank next to man in the scale of intelligence. Myers quotes some of Lubbock's experiments with ants, and mentions recent experiments with the higher apes, which prove that the latter rank next to man in individual intelligence as in bodily structure.

Note 4.—A useful list is given of many of the various artificial observation-nests used since Lubbock's time; it may be added that Lubbock's nest, after being modified in a number of ways, is still widely used.

Note 12.—Myers gives the following five main possibilities by which the origin of castes in the social insects may be explained :—

(1) The eggs are all alike, and the different castes are produced by feeding. This is the view usually held by students of bees.

(2) The eggs are intrinsically different and each caste develops from a different kind of egg. Feeding at most only influences stature.

(3) The eggs are all alike, but each has either a definite nuclear structure, which responds to special food so as to produce a specific caste, of differential potentialities, which may react specifically to a particular kind of food.

(4) The castes may be predetermined in some groups of social insects and produced by feeding in others.

(5) Some of the castes in a given species may be predetermined, while others are caused by differential feeding.

He then proceeds to state the different views and theories of various authors on the subject.

At the end of the annotations an admirable, short "Reading List" is given.

This excellent work is well printed and produced, and its subject is ably treated; we can heartily recommend it in every way. It should be in the hands, not only of all myrmecologists, but of all serious students of entomology and of animal behaviour.

Insect Singers: a Natural History of the Cicadas. By J. G. MYERS. Pp. xix + 304, with 7 plates and 116 figures. (London: George Routledge and Sons, Limited. 1929. 21s.)

WERE it not for the sub-title, which gives a true indication of the contents, exception might be taken to the title of this book as being misleading. Actually it is doubtful whether a more complete work on the natural history of any one family of insects has ever been produced, and it is to be regretted that practical considerations involved in the publication of a popular volume have necessitated the limitation of space which has cramped the author's work. This small book, indeed, contains enough matter for several volumes, and the resulting concentration, together with the mass of quotations and references, makes reading difficult if fascinating.

In the presentation of his subject Dr. Myers has adopted the historical method of treatment. In the two opening chapters he gives an absorbing account of the Cicadas in Mythology, Art, and Literature, from Homer to the present time. These are followed by chapters on the structure, classification, evolution, life history, distribution, relations with plants, other animals, and man, psychology, behaviour, and song, each section being prefaced by an historical summary. The chapters on structure are extremely technical and difficult for the non-specialist to follow. Although well illustrated by detailed figures, these are not easily elucidated from the text, and we believe it to be a mistake to collect the text-figure legends under a separate list of illustrations. There is no annotated large-scale figure of a Cicada to show relationships of the parts, such as one might have expected to precede this section in a more or less popular volume, and it is consequently almost impossible for a beginner to grasp the general anatomy of the insect. With regard to the classification, although a new system is postulated on p. 85, practically no indication is given of the characters upon which it is based, so that the student will be unable to make use of it. The chapter on Cicada song is quite unique, and largely consists of original work, in which the author's wife has participated. The songs of many species have been accurately recorded. The book closes with a very complete bibliography, although we notice that reference is made only to the old edition of Folsom's "Entomology." On the whole the illustrations, especially the plates, are poor and are scarcely worthy of the general excellence of the subject-matter. Although plates are given of three abnormal forms occurring in Australia and South America, there is no good figure of a normal Cicada. Amongst other things, we have been puzzled by the indiscriminate use of clarendon and italic type for generic and specific names. Apart from the above-mentioned faults, for most of which he is not responsible, the author is to be congratulated on having produced a volume of outstanding value, which is a monument of painstaking labour, shows an amazing intimacy with the literature of the subject, and is a model for future workers. This work is, of course, quite indispensable to all students of the Homoptera, and can confidently be recommended to the general reader.

The Insects of Bermuda. By LAWRENCE OGILVIE, M.Sc. (Cantab.), M.A., B.Sc. (Aberdeen). Pp. 52. (Department of Agriculture, Bermuda. 1928. 1s.)

THIS is a carefully-compiled list of all the insects at present known to inhabit the island of Bermuda, together with popular names, notes on feeding-habits and other important data, and a useful bibliography. The work has been accomplished with the co-operation of specialists in the different Orders of insects, and represents a considerable amount of research. It will be of great value to residents in Bermuda and all who may have occasion to study any part of the insect fauna of the island. As an Appendix, a description of a new species of *Aphis* by Professor F. V. Theobald has been included.

The Natural History of Wicken Fen. Edited by PROF. J. STANLEY GARDINER, F.R.S. Part V. Pp. 385-487, with 4 plates and 11 figures. April 1929. (Cambridge: Bowes and Bowes. 5s.).

THIS publication includes three articles, dealing respectively with the vegetation, the Diptera and the Trichoptera of Wicken Fen. Messrs. H. Godwin and A. G. Tansley deal at some length with "the fen vegetation as distinct from flora," and show how the plant associations now existing in the fen have been developed from the original reed-fringed mere to the present diversity of type. In the attainment of this diversity agricultural and other operations of man are shown to have played a large part; sedge-cutting, for example, having the effect of destroying the dominance of *Cladium mariscus* and favouring the development of *Molinia* and other plants which cannot normally obtain a footing owing to the mattress of dead leaves under the ever-green *Cladium*. Variation in the frequency of cutting produces different results, and though, as pointed out by the authors, "each plot has had a past history of cropping, natural development and clearing, now impossible to discover," it would hardly be too much to say that every human operation has left its impress on the vegetation of the fen: there, as elsewhere, the present is an epitome of the past.

Communities are no more immortal than individuals, and the inevitable result of progressive drying and silting is that the animals and plants now characteristic of the fen will disappear. The authors show that under present conditions of climate and soil the whole fen, if left alone, would in a few decades become covered with a dense growth of bushes or *carr*, the last stage in the vegetational succession in this area, which is hardly dry enough for the final development into deciduous forest. This stage may, however, be postponed, and the fen retained in something like its present state, by a continuance of periodical cutting as planned by the National Trust. Such operations are as necessary for the preservation of the fauna as of the flora, for the animal life is more or less directly dependent on the vegetation both for food and shelter, and though some factors of climate and soil (such as alkalinity of the peat) may have a direct influence, these factors for the most part affect the composition of the fauna through their influence on the vegetation. Messrs. Godwin and Tansley's paper should logically, therefore, have been placed first in the series.

Mr. A. P. G. Michelmores contributes an introductory account of the ecology of the Diptera, dealing with the relative abundance of different families, the limiting factors of the environment, and the fly associations of the different habitats within the fen. Insect ecology is much more complex than plant ecology, partly because the adults at least are usually free to wander at will, and partly because of the frequent restriction of feeding to the larval stage, and the great variety of feeding-habits, including predacity and parasitism. From the ecological point of view alimentation is of more importance than locomotion, and therefore, a study in insect ecology should be, in the main if not entirely, a study of larval habits and associations. In the case of Diptera, however (as of most

other insects) our knowledge is not yet sufficiently advanced for such studies to be made in detail. At present ecological studies, such as this paper, must deal largely and only very generally with the adults, especially those of more sedentary habits. Some examples are given of the remarkable restriction in range of some species to particular spots on the fen. A case of this nature came to the writer's notice some time ago. In 1915 he found the midge *Chironomus prasinatus* common in one spot only at the end of the main drove. In 1927 Mr. W. D. Hincks visited the fen to collect midges; the writer informed him of the station where he had taken *C. prasinatus*, and Mr. Hincks again found the species in the same area and there only. Why such insects as *C. prasinatus* and *Dicraeus ingratus*, which can and do use their wings, should be so confined in their distribution has yet to be explained. Another minor problem to be worked out is the relation between the various Dipterous inquilines found living in the galls formed by *Lipara lucens* on reed. The writer has reared all three species mentioned by Mr. Michelmores from specimens of these galls collected in other localities. Mention is made of the paucity of the insect fauna of the pure sedge areas, in contrast with the hedgerows in adjoining lanes. Yet it is probable that some species breed in the "dead-leaf mattress" of *Cladium*; some may be more or less peculiar to this habitat, as is the case with other types of leaf-mould. An interesting observation is made of the occurrence of minute black flies on the wings of a large-dragon fly, and it is suggested that these may have been *Scatopse*; it is much more likely that they were a *Forcipomyia*, members of which genus have been found on dragon-flies' wings in West Africa and Sumatra, though not previously in this country. No faunal list of Wicken Diptera is given, but this will presumably be published in a subsequent part, and should include at least a thousand species.

The third paper in this part is by Mr. A. H. Wood on the Trichoptera, who gives notes on the 37 species of this order known to occur in the fen. Some errors in the spelling of authors' names need correction: Wesenburgh-Lund should be Wesenberg-Lund, and Mosley should be Mosely.

STAFF NEWS.

MR. MICHAEL ROGERS OLDFIELD THOMAS, F.R.S., who died on June 16, aged seventy-one years, had retired from the service of the Trustees in 1923, but up to within a few days of his death he notwithstanding continued working at the Museum. He first joined the staff in the Office at Bloomsbury in 1876, but two years later, in 1878, was transferred to the Department of Zoology, of which Dr. A. Günther, F.R.S., was at that time Keeper, and after serving for a short time as Dr. Günther's clerk he was placed in charge of the Mammal collection, retaining that post until his retirement. He assisted in supervising the removal of the Department to South Kensington in the years 1882 and 1883, and there devoted his energies to building up the present unrivalled collection of mammals. To that purpose he gave much of his own money and gathered together other funds, and was successful in attracting voluntary workers to assist in arranging and working out the large number of specimens that steadily flowed in. One of his last acts was to make the Trustees the gift of a considerable sum of money to enable a private lift to be installed in the western central tower to work from the Basement up to the Cryptogamic Herbarium. As his study and the Mammal collection were on the Second Floor, he had found with increasing years the need for some mechanical means

of access to the upper floors. The plans for the lift have been approved and the work will be begun in August. When completed the lift will form a memorial to one whose whole heart was in his Museum work.

Oldfield Thomas was born at Millbrook, Bedfordshire, on February 21, 1858, his father being Vicar of Hillingdon, Uxbridge, and afterwards Archdeacon of Cape Town, and was educated at Haileybury College. He entered the Museum immediately on leaving school. Gifted with a keen eye, a supple wrist, and unusual agility, he excelled at every game which he took up; quite late in life he regularly participated in the principal croquet tournaments. He married the daughter of Sir Andrew Clark, Bart., M.D., F.R.S., the eminent physician; she died in 1928. There was no family.

* * * * *

Dr. L. J. Spencer, M.A., Sc.D., F.R.S., Keeper of the Department of Mineralogy, is one of the representatives of the British Government at the forthcoming International Congress of Geology at Pretoria, South Africa.

* * * * *

Dr. C. Tate Regan, M.A., D.Sc., F.R.S., Director, and Dr. G. F. Herbert Smith, M.A., D.Sc., Assistant Secretary, represented the British Museum (Natural History) at the Annual Conference of the Museums Association at Worthing in July.

* * * * *

Dr. Errol I. White, Ph.D., Assistant Keeper in the Department of Geology, has joined the Franco-British-American Ornithological Expedition in Madagascar. Dr. White's share of the work is to collect fossil birds.

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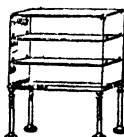
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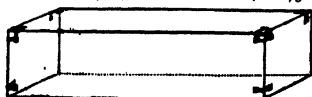


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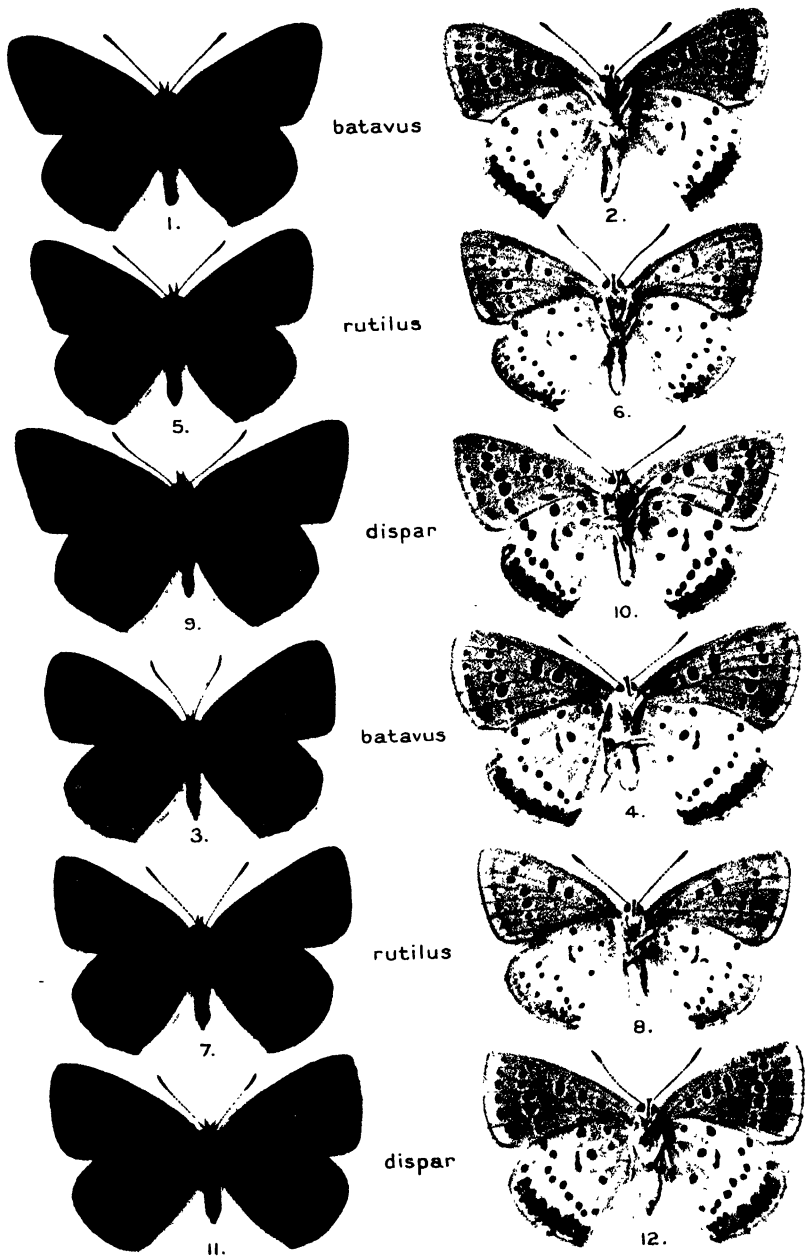
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THREE RACES OF *CHRYSOPHANUS DISPAR*:
BRITISH (*DISPAR*), DUTCH (*BATAVUS*) AND CONTINENTAL (*RUTILUS*).

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No. 12

OCTOBER, 1929

Vol. II

THE RE-ESTABLISHMENT OF THE LARGE COPPER BUTTERFLY (*CHRYSOPLANUS DISPAR*) IN ENGLAND.

By N. D. RILEY, Assistant Keeper, Department of Entomology.

(PLATE I)

It would be a sad reflection upon the earlier British entomologists were it true, as is often alleged, that the first account of the Large Copper Butterfly, as it occurred formerly in England, appeared in a German publication printed and issued at Erlangen in the latter half of the eighteenth century. It is often stated that the figures of "*hippotohœ* var.", male and female, occurring on plate xxxviii of Esper's "*Die Schmetterlinge in Abbildung nach der Natur mit Beschreibung*," represent the extinct British race so admirably illustrated in the plate—for which we are indebted to the Entomological Society of London—that accompanies this article. Esper's plate was published in 1777; two years later the corresponding text appeared, and in this Esper remarked that, although the exact origin of the specimens figured was unknown, the insect was said to be common in Switzerland, Hungary, and Austria. It is almost inconceivable that Esper should have figured in 1777 an insect that was discovered by British entomologists only between 1790 and 1800. The explanation appears to be that Esper's figures are bad representations of the continental form (*rutilus*), an explanation that is strongly supported by a careful comparison of his figures with those now given, in the production of which no artist has been employed.

The earliest English examples of which there are records appear to have been taken in Cambridgeshire. Subsequent records show that the insect occurred over a fairly wide tract of the fen country lying in Huntingdon and Cambridgeshire (Yaxley, Trundle, and Whittlesea Meres, Holme Fen) and also in all probability in Norfolk (Bardolph Fen) and Suffolk (Benacre). Locally it was abundant; contemporary publications make allusions to "several hundreds being taken by London collectors" in Whittlesea and Yaxley Meres alone between 1820 and 1840. In 1844 or 1845 the caterpillars could still be bought "for about

sixpence each," yet three or four years later the insect had disappeared. A good deal has been written at one time or another upon the probable causes of the extinction of this "glory of British entomology." It is very generally supposed that the fen-drainage schemes that were carried out in the early part of the nineteenth century had some effect upon it, but it does not seem possible to account for its disappearance entirely in this way. For example, Whittelsea Mere, which, with its satellite Trundle Mere, was perhaps the main stronghold of the butterfly in England, was not in fact drained until five or six years after the last recorded capture of the insect. Holme Fen, again, where the last captures were made, has never been completely drained and remains to-day almost exactly as it was in 1847-48. Possibly in early days *Chrysophanus dispar* occurred throughout the whole of the fen country, being restricted later to its fringes, which it inhabited when first discovered, by the extensive drainage carried out in the eighteenth century and earlier. But in any case its predilection for restricted flight areas, which are a feature of its occurrence—in Holland it occurs in a number of quite small isolated patches—made it an easy prey for collectors; moreover, the butterfly itself is so conspicuous an object when on the wing that it is almost impossible to overlook it, and its caterpillar is equally conspicuous upon the leaves of the Giant Water Dock (*Rumex hydrolapathum*), upon which it feeds. That the depredations of collectors were severe will be evident from the following quotation of a passage (*Entom.* xvi. p. 130) from the "Entomological Reminiscences" of H. J. Harding, a professional collector:

"About forty years ago [1840] Mr. Benjamin Standish (the grandfather [a dealer]) heard that *dispar*, as then called, had been seen in the Fens. *Dispar* was known and figured in 1792 and 1795. He got a painting of the butterfly, coloured by his father, and went down to the Fens and showed it to people there, but no one knew anything about it. Mr. Drake, at the 'Checkers' told him that a man lodged there who worked in the Fens, cutting reeds, who was a most likely person to know. When the man returned from work Standish showed him the drawing, and said, 'Do you know anything about a butterfly like this?' 'Yes,' said the man; 'I saw some to-day.' 'Well,' said Standish, 'what shall I give you to take me to the spot?' 'No!' said the man, 'I intend to take a lot up to London.' Standish then offered him five shillings to take him to the place, but the man would not divulge the locality, even for a promise of two shillings for each insect captured. The landlord, however, told Standish where the man worked, and he was successful in finding the place, and took a fine lot of *P. hippothoë* [i.e. *dispar*]. It soon got wind among the folks at the Fen that they were worth two shillings each in London, and two men came from Cambridge and secured a large quantity, which they took to London in boxes full, and sold them at sixpence each. I went down about three years after, and got some of the larvæ. They appeared to be very local,

and most numerous where their food-plant—viz. the water-dock—was most abundant. The larva was collected by all persons, young and old. I bought two dozen larvæ of an old woman for ninepence, from which I bred some fine specimens, and sold them at one shilling each. I wish I had them now. Mr. Cole, at Holme Fen, took a large quantity of them. His back-yard was close to their locality. The last time I was there Mr. Cole said he had not seen one for some years. There was the food-plant in plenty on the same spot, but no larvæ. They had been too closely hunted for."

There is no doubt in the writer's mind that the Large Copper Butterfly of the fens was exterminated by collectors, although possibly professed entomologists were not directly to blame so much as the local larva-collectors, mostly reed-cutters and the like, who supplied the dealers and others for gain, in the same way that they still supply pupæ of the Swallow-tail Butterfly (*Papilio machaon*).

At intervals during the last twenty or thirty years the possibility and desirability of attempting to re-stock the fens with colonies of the Large Copper Butterfly derived from Continental sources has been discussed. Many of the smaller fens are, so far as can be ascertained, even now virtually unaltered and well filled with the Giant Water Dock, and therefore in all probability could be easily adapted to support colonies of the butterfly. The desirability of doing this is certainly debatable, but the arguments on either side are not very weighty and therefore it seems that, if a body of entomologists is ready and willing to undertake and carry on the experiment voluntarily with only such financial support as may be freely given, then they deserve every encouragement. There can be no fear of "vitiating local records" by confusion with "imported Continental stock"; on the other hand, it will be very interesting to observe whether the imported stock shows any tendency to vary in the direction of its extinct ally, whose haunts it now frequents.

When the Entomological Society of London set up its Committee for the Protection of British Butterflies, its intention was that the status of all threatened species which were brought to its notice should be inquired into, and that such steps as were possible should be taken to protect them. One of the most satisfactory of protective measures is undoubtedly the formation of fresh colonies upon enclosed or otherwise reserved land, and it is therefore not unnatural that, when a suggestion was again made that *C. dispar* should be reintroduced, the Committee took the matter up. Indeed, the Committee considers the furtherance of work of this nature to be one of its aims. It was extremely fortunate in having from the outset the active

support of Capt. Purefoy, whose knowledge of the habits of the Large Copper Butterfly is quite unrivalled, he having maintained a flourishing colony of the *rutilus* form on an estate in Southern Ireland since 1913.

Previous to 1913 the only attempt to introduce *C. dispar* to England was made at Wicken Fen by the late G. H. Verrall, who liberated a number of caterpillars there. The food-plant is not very plentiful in that Fen, however, and the butterfly quite failed to gain a foothold.

The first attempt at colonization under the auspices of the Entomological Society was made in 1926 in Norfolk, Mr. John Cator, of Woodbastwick Hall, kindly placing some of his land at the disposal of the Committee. This was stocked with a very large number of butterflies sent over as pupæ by Capt. Purefoy so that they could emerge and be liberated on the spot. Evidence of the insect's continued existence there in small numbers was obtained in 1927 and again in 1928. It was not thought, however, that anything would be seen of the butterfly this year; but, contrary to expectation, very encouraging news has just been received suggesting that it has after all secured a firm foothold in the locality.

In all these experiments the insect used was the ordinary Continental form known as *rutilus*, the stock of which came from the Berlin marshes. In 1915 there was discovered in the marshes of Friesland in Holland a race of *dispar*, since named *batauvus*, that differed markedly from *rutilus* and appeared at first sight indistinguishable from the extinct British *dispar* (see plate).

For the next attempt the Committee had been so fortunate as to obtain permission from the Society for the Promotion of Nature Reserves to utilize Woodwalton Fen in Huntingdonshire, which had been bequeathed to the Society by the late Hon. N. Charles Rothschild. As this fen is actually situated within the area formerly occupied by the British *dispar*, it seemed most appropriate to make the attempt at colonization with the recently discovered Dutch race rather than with the ordinary Continental form. The fen, however, had been much neglected and, before it could be used, an area of twenty-two acres was cleared under the direction of Capt. Purefoy. *Rumex hydrolapathum* was growing in abundance along the dykes, but not to any extent elsewhere, and this necessitated planting many hundred clumps of it out in the open, in which situations alone will *dispar* use it for egg-laying. The clearing allowed many flowering plants to make good, and these were supplemented by beds of annual

candytuft which were sown in the spring of 1927—marsh ragwort, marsh thistle, watercress, etc., all of which have proved in Capt. Purefoy's experience peculiarly attractive to the butterflies.

The experiment was very nearly wrecked at the outset, however, by the cupidity of the Dutch collectors,* for when the time came in 1927 to obtain the caterpillars from Friesland, the utmost difficulty was experienced in finding any at all. The butterfly appeared to be on the point of extermination in Friesland; only fourteen larvæ were found after a very prolonged search. These, together with thirty-three raised in captivity from eggs obtained in 1926, represented the entire stock liberated at Woodwalton Fen in 1927, and included only thirteen females. Some of the females were subsequently recaptured, and from them eggs were obtained so that a stock could be reared in captivity. This precaution, however, proved almost unnecessary, for the wild stock flourished to such an extent that in July 1928 there were already large numbers of the insect to be seen flying about the fen. This year, unfortunately, the numbers do not seem to have been so great, but the weather at the end of July and the beginning of August was so bad that it was impossible to make a ready comparison with 1928.

The only disquieting factor so far in connexion with the Dutch Large Copper Butterfly has been the attacks of parasites, both hymenopterous and dipterous, but principally the latter. Curiously, the Irish colony of German descent (*rutilus*) has never yet suffered from these attacks, yet it is estimated that this year seventy-five per cent. of the larvæ at Woodwalton Fen were destroyed by *Phryxe vulgaris*, a Tachinid fly of all too catholic tastes. That the larvæ should be able to withstand flooding was only to be expected. It was not anticipated, however, that in their first winter they would be submerged for sixty days, and the fact that they survived this extreme test successfully was very reassuring. Small-scale experiments tend to show that this ability to withstand immersion is largely dependent upon the nature of the soil. A flood welling up through a peat soil appears to have no deleterious effects, but a short flooding over ordinary soil induces quite a heavy death-rate. It is feared that if the attacks of *Phryxe vulgaris* continue on the same scale as in 1929, it will be necessary always to maintain a reserve stock

* It appears that *C. dispar batavus* is still to be found in a few very restricted areas in Friesland, but in such reduced numbers that Dutch entomologists have already tried to form a protected colony of it elsewhere. The first attempt, however, has not proved very encouraging. If another attempt be made it is not unlikely that the material for it may have to be supplied from England!

in hand in captivity as a precautionary measure. The only alternative would be the clearing of a far greater area of the fen so that the larvæ could be more widely distributed and the densely colonized areas, which are peculiarly susceptible to attack, got rid of. This unfortunately would be such a costly operation that without some totally unprecedented addition to its funds the Committee could never hope to achieve it.

A much fuller account of these experiments, together with an analysis of the characters that serve to distinguish the three races involved, will be found in the *Proceedings of the Entomological Society of London*, vol. iv, part i, 1929, to which account the writer is indebted for much of the information given above.

FUR RABBITS.

By J. GUY DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

SIX varieties of domesticated rabbits have recently been presented to the Museum by Mr. E. Bostock Smith; these have been mounted in the Rowland Ward Studios and are now on exhibition among the series of domesticated animals exhibited in the North Hall. The six varieties represent the six principal fur breeds, that is: Chinchilla, Blue Beveren, Argente de Champagne, Havana, Black and Tan, and Maraaka.

The coat of the Chinchilla rabbit resembles in general effect the real Chinchilla fur, the pelt being silky in texture and mottled pearly-grey in colour. The thickness of the fur in this breed is of greater importance to the furrier than the actual length of the hair, good skins having the hair very dense and silky; the number of hairs to the square inch, and the silkiness and colour of the coat are the chief characters by which a skin is judged. Some of these rabbits are brown-backed when young, the brown tinge disappearing when the first coat has been moulted. The colour, as laid down in the standard of points for chinchillas (adopted by the National Chinchilla Club), should resemble as much as possible the real chinchilla fur; the basal portion of the hairs should be slate-blue, an intermediate area pearl-grey, becoming white towards the tip, which is black. A number of long, black hairs are interspersed with the body fur. The points as regards the texture and density of fur include the fact that the fur should be about one inch to one and a half inches in length, and should not exceed this latter measurement. The

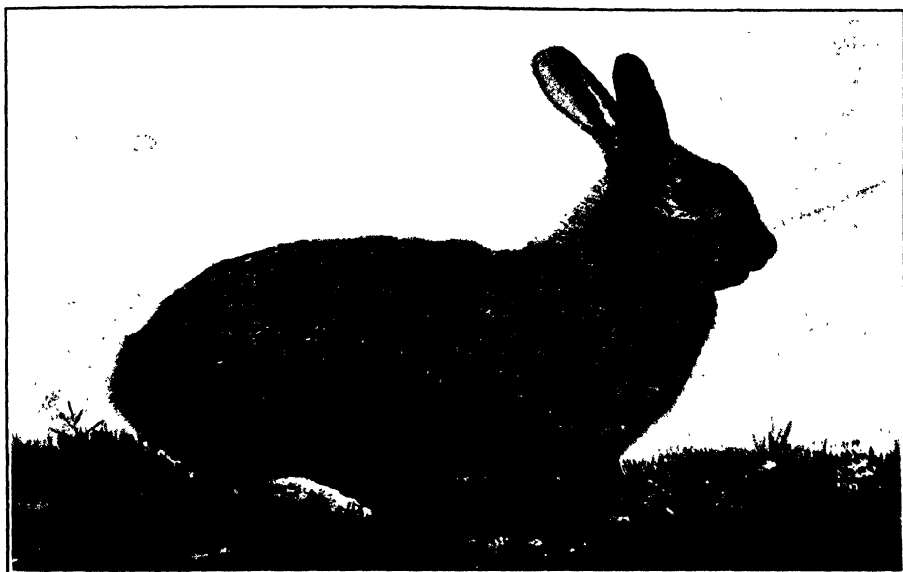


FIG. 1.—CHINCHILLA.



FIG. 2.—BLUE BEVEREN.

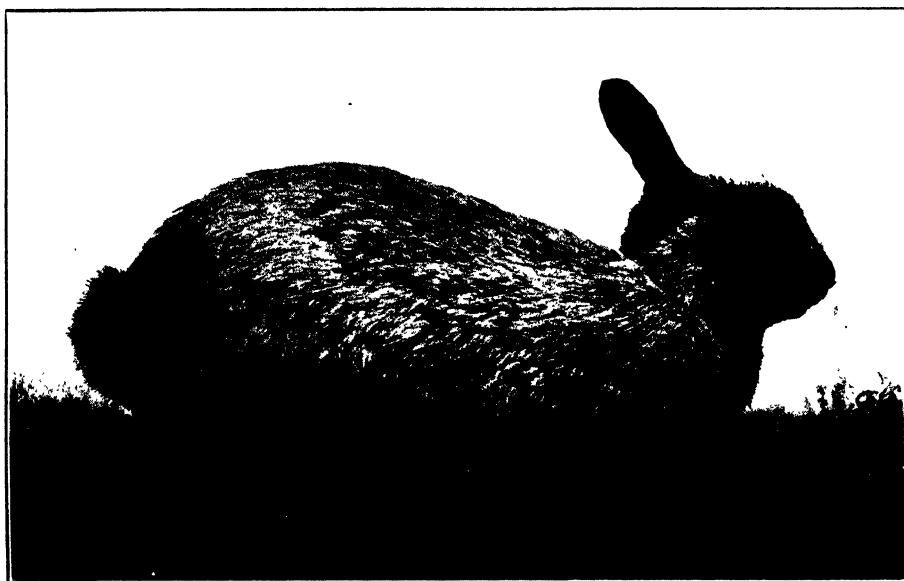


FIG. 3.—ARGENTE DE CHAMPAGNE.

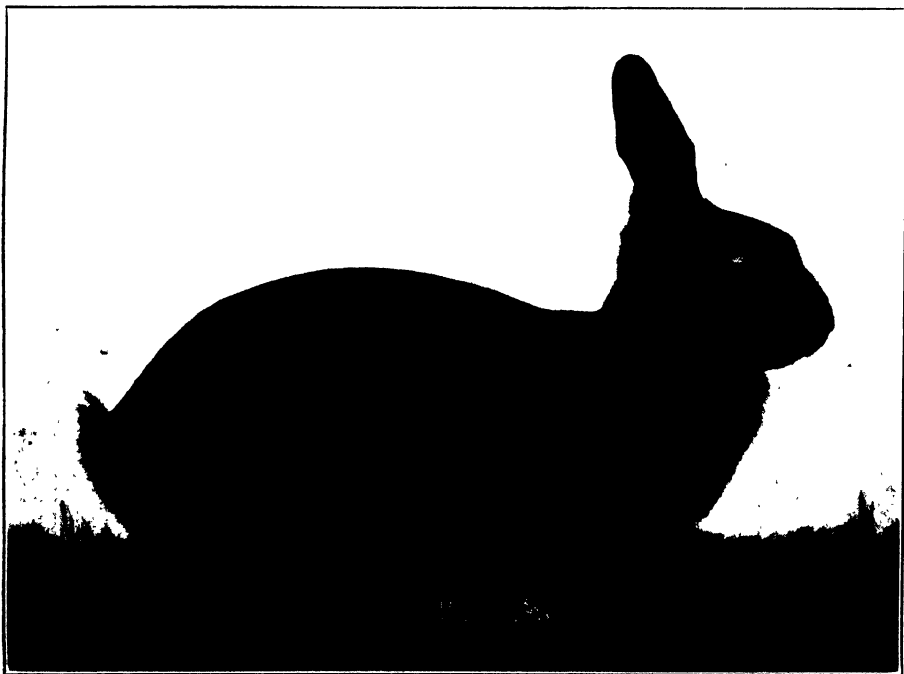


FIG. 4.—HAVANA.

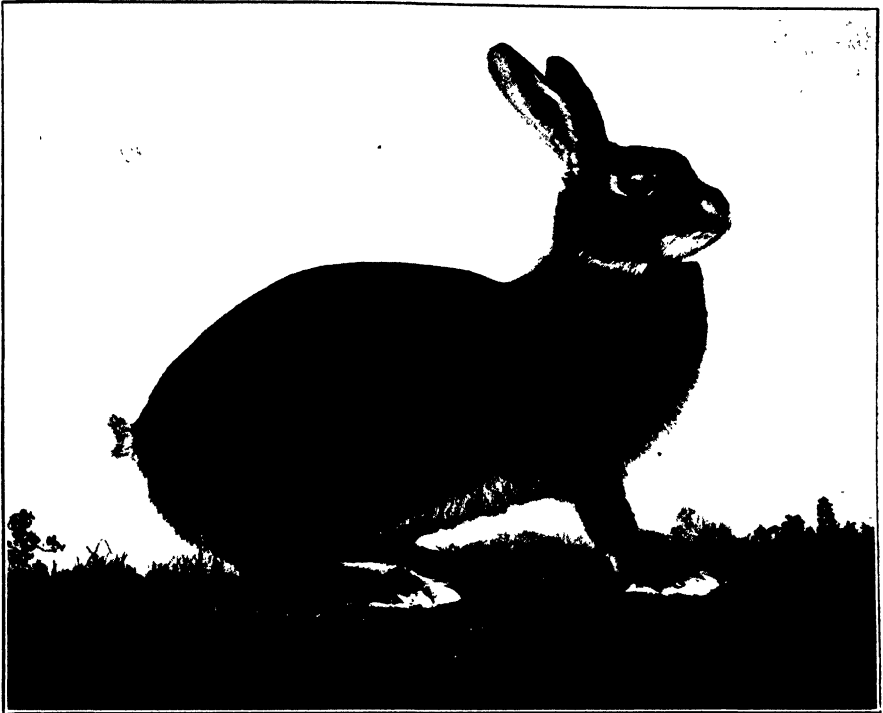


FIG. 5.—BLACK AND TAN.

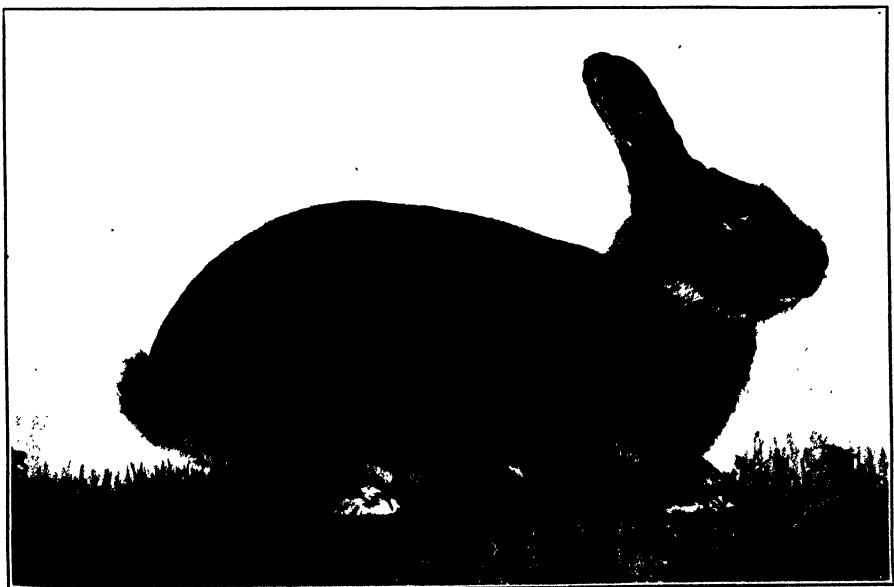


FIG. 6.—MARAAKA.

weight should be from $5\frac{1}{2}$ to $6\frac{1}{2}$ lb. and the shape neat and cobby. Disqualification arises from the presence of white patches on the body and odd-coloured eyes; barred feet and the presence of a dewlap are considered as faults.

A somewhat similar rabbit is the breed known as the Blue Beveren, which is larger than the Chinchilla, the weight being over 7 lb. Skins of this animal are in much demand, as the fur is exceptionally hard-wearing and can be used for a number of purposes. The fur should be long, thick, and soft, and the colour a kind of lavender blue. The shape of the animal should be of the "Mandoline" type, that is, with a long, broad back, so as to get as much of the back fur as possible. The eyes should be a brilliant blue; any other colour is considered a fault. Blue Beveren pelts are much used for making up into coats and similar garments, the extreme softness of the fur and the pleasing colour effect producing some very beautiful results.

The breed known as the Argente de Champagne was introduced into this country from France. The colour of the coat is here silvery grey, whiter than in the Chinchilla, and the mixture of tints more even; as in the Chinchilla, however, the silvery shade is made up of black and white hairs with an under colour of slaty-blue. A striking point about this breed is that the young are quite black when born, the transition to the grey coat taking place when they are about six weeks old. The change in colour commences at the nose and spreads backwards, breaking out in patches all over the body, until an even tint is arrived at. The weight should not be under 7 lb. or over 10 lb.; the coat should be long, dense, and silky, and the eyes dark brown.

The Havana rabbit is a medium-sized animal, the weight being about 6 lb. The coat is very handsome, being a rich chocolate or liver-brown throughout, and extremely dense; there should be as many hairs to the square inch as possible. Depth of colour is of great importance in this breed, and as the colour tends to bleach very easily, these rabbits should never be exposed to direct sunlight. The eyes are the same colour as the coat, and glow ruby red in a subdued light. The general shape is compact and cobby, with a short neck and back and wide hind-quarters.

The Black and Tan is one of the smallest breeds of rabbit; it has only recently been recognized as a fur variety. This rabbit is really a black animal, with flanks and underparts of deep, golden tan. The weight of this breed is only about 3 to $4\frac{1}{2}$ lb., and the fur should be dense and without white hairs.

One feature of the Black and Tan which appeals to the fur breeder is that they require very little food.

The Maraaka is a dark brown breed, introduced by Mr. Bostock Smith. The markings of this rabbit are very similar to those of the Black and Tan, except that where the latter has tan colouring the Maraaka has white. There are two types of Maraaka, a light and a dark form. Its weight rarely exceeds $5\frac{1}{2}$ lb., and the coat should be dense and silky in character. In addition to the excellence of the pelts, this breed commands good prices for table purposes, as the Maraaka is a small-boned rabbit, carrying an abundance of meat.

The coats of these specimens are all in excellent condition, as Mr. Bostock Smith was able to select good examples from his extensive series at times when their coats were in their prime. It is to be hoped that breeders of other domesticated animals will see their way to present specimens in the same manner. The collection of domesticated animals should, as far as possible, consist of animals in their prime, and not, as is frequently the case, of animals which have died of old age.

RESEMBLANCE AND DIVERSITY AMONG INSECTS.

By DAPHNE AUBERTIN, M.Sc., Assistant Keeper, Department of Entomology.

It is well known that insects outrival all other groups in the animal kingdom as regards number of species and variety of shape; in fact, at the beginning of an intensive study of any order, a considerable time elapses during which the student is painfully conscious of his inability to "see the wood for the trees." The range of form met with in the order Diptera (two-winged flies) alone may be taken as an illustration of this point.

In the mind of the general reader the term "fly" is probably associated with the common house-fly, or the "blue-bottle," but Fig. 1 shows a diverse group of characteristic flies selected from several families. The variety of form is at once apparent, every part of the body being subject to modification. In *Tipula* (e) the legs are abnormally long and the body thin, whereas in *Bombylius* (b) the body is short and covered with hair, which gives it a furry appearance; in *Laglaisia* (a) the eyes are placed at the ends of long stalks; in *Rutilia* (f) the body is thick-set, with a metallic iridescent pattern and stout bristles,

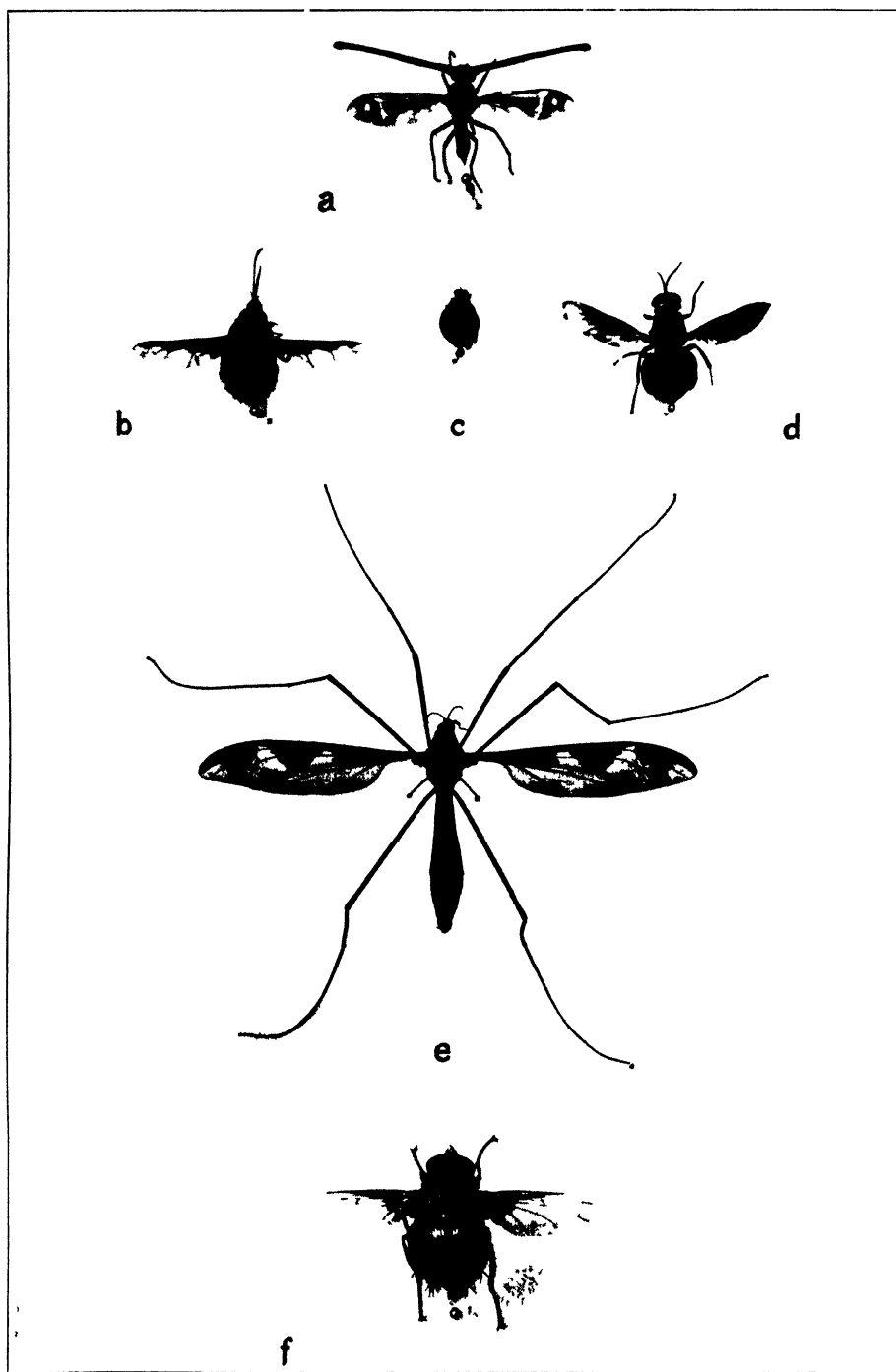


FIG. 1.—a, *Laglaisia* ; b, *Bombylius* ; c, *Paraclyphus* ; d, *Cyphomyia* ; e, *Tipula* ; f, *Rutilia*.

whereas in *Paracelyphus* (c) the posterior extremity of the thorax is inflated and extends so far backwards that the wings and abdomen are entirely hidden beneath it, and the insect thus acquires a superficial resemblance to a lady-bird.

This striking variety of form within a single order is counter-balanced by the occurrence of certain resemblances, generally known as "mimetic," which exist between members of species belonging to different orders. Insects illustrating a beautiful case of resemblance have recently been presented to the Museum by Mr. R. O. Jermyn, I.A. While serving in India Mr. Jermyn caught several specimens of the Dipteran *Cerioides eumenoides*, and also a number of the Hymenopteron *Eumenes esuriens*; he found the insects flying together and could distinguish them from one another only after close inspection. A specimen of the fly (a) and the wasp (b) are shown in Fig. 2. The interest of the resemblance lies in the colour, a light brown with lemon-yellow

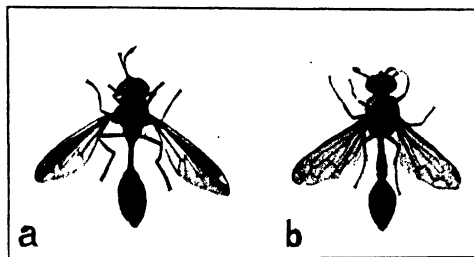


FIG. 2.—a, *Cerioides eumenoides*; b, *Eumenes esuriens*.

markings, since the general shape of the insects is common to both genera. No connexion between the life-histories of the two insects has been established, but it is known that certain members of the family Syrphidæ, to which *Cerioides* belongs, pass the early part of their life-history in the nests of Hymenoptera, and one is tempted to imagine that this may be a true case of "mimetic resemblance," in that the fly obtains easy access to the wasp's nest for the purpose of oviposition, on account of its "waspish" appearance.

The assumption that resemblances between unrelated insects are "mimetic," although true in some cases, has been carried at times to unwarrantable lengths, and it must be borne in mind that there is a vast number of cases of resemblance between insects in different orders where there can be no question of "mimicry." A few of these fortuitous resemblances are shown in Fig. 3.

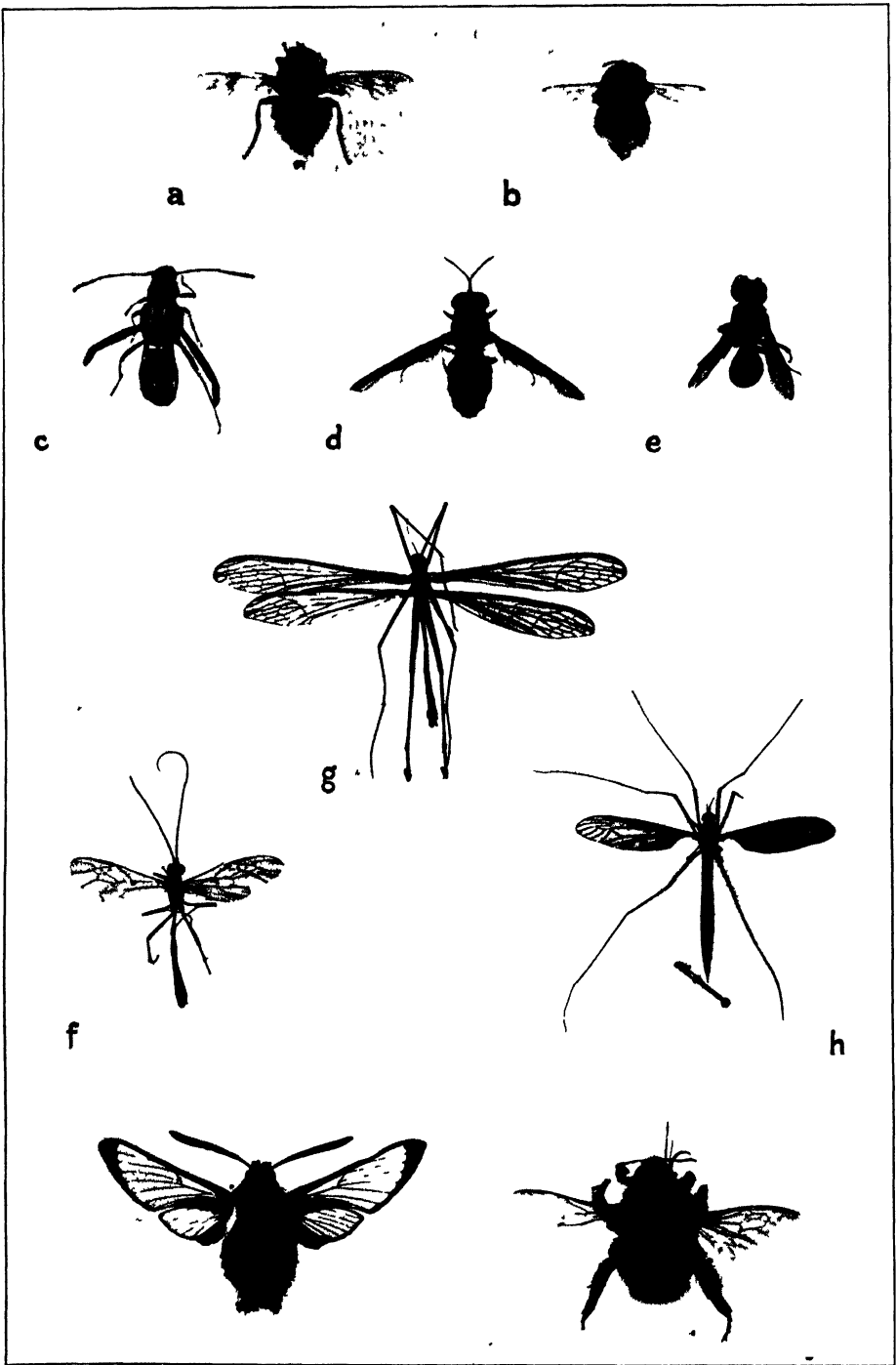


FIG. 3.—a, *Pocota*; b, *Bombus*; c, *Esthesis*; d, *Syndipnomyia*; e, *Crabro*; f, *Ophion*; g, *Bittacus*; h, *Pachyrrhina*; i, *Hæmorrhagia*; j, *Bombus*.

Pocota apiformis (a), a fly, and *Bombus hortorum* (b), a bee, both occur in Britain, but there is no known connexion between them. Figure 3 (c, d, e) shows species of *Esthesia* (c), a beetle, *Syndipnomyia* (d), a fly, and *Crabro* (e), a Hymenopteron, which occur in Australia. In all three forms the body is black with brilliant orange markings on the abdomen; in *Syndipnomyia* the colour is produced by short thick orange hairs, but in the other two it is formed by bands of pigment in the chitin. *Ophion* (f) is an Ichneumon, *Bittacus* (g) is one of the Neuroptera, and *Pachyrrhina* (h) is a Dipteron, but all have a similar characteristic appearance produced by abnormally long legs, narrow wings and elongated abdomen. *Hæmorrhagia* (i) is a Bee-hawk moth, and *Bombus* (j) one of the bumble-bees, but their general appearance is very similar.

An exhibit drawn from Museum material, illustrative of these notes but covering a wider range of morphological variation, has recently been placed in the Central Hall. The occurrence of parallel forms in different orders of insects, and the wide morphological range existing in any one order, are facts of equal interest to the student of variation, since no explanation covering all the known cases of similarity and dissimilarity has yet been advanced.

THE MOUNTAIN SHRIMP OF TASMANIA.

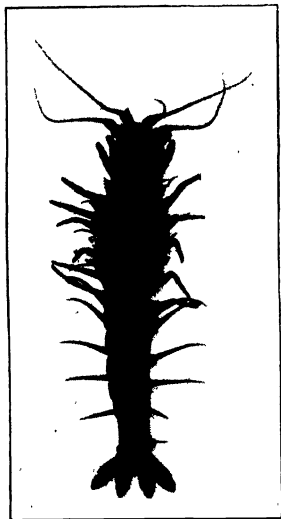
By PROF. G. E. NICHOLLS, D.Sc., University of Western Australia, Perth,
Western Australia.

CONSIDERABLY more than seventy years ago there were described, under the name of *Gampsonyx*, certain fossilized shrimp-like creatures from the Coal-measures of Europe. Somewhat similar forms were presently found fairly common in beds of the same age in Great Britain and North America. Some difficulty in classifying these specimens was experienced by the several writers who described them, for in their structure they transgressed in all directions the boundaries prescribed for the recognized orders of extant Malacostraca. Their closest relationship appeared to be with the small marine shrimps placed at that time in a group Schizopoda.

It is to Packard, thirty years later, that we owe the establishment of a sub-order, Syncarida, for these extinct Malacostraca. In giving his reasons for this action, Packard concluded: "We are compelled, therefore, to regard the group . . . as standing near

or at the base of the Thoracostraca, not far from the Stomapoda and Schizopoda, and . . . as an annectent or synthetic group, pointing to the existence of some extinct group which may have still more closely connected the sessile-eyed and stalk-eyed Crustacea."

About the time when these words were being penned, there were known to the settlers in southern Tasmania, and said sometimes to have been eaten by them, the two-inch dark brown shrimps



THE MOUNTAIN SHRIMP OF
TASMANIA.

that might be taken abundantly in the clear cold water of crevices and runnels upon the summit of Mt. Wellington more than 4000 ft. above sea-level. It was not, however, until January 1892, when the New Zealand carcinologist, Mr. (now Sir) G. M. Thomson, collected his specimens, that *Anaspides* first underwent scientific scrutiny. Thomson briefly described his find in a short paper in the *Proceedings of the Royal Society of Tasmania*, and presently gave a much fuller description in the *Transactions of the Linnean Society of London*. He remarked: "This animal is, I think, one of the most remarkable Crustaceans found of late years"; but even he failed to realize the real importance of his find, and it is to Calman that we owe the recognition of the fact that in the "Tasmanian mountain shrimp" we

have a survivor, scarcely visibly modified, of those ancestral Syncarids which swarmed in the swamps and along the coasts of the seas of Carboniferous times.

Another naturalist, Geoffrey Smith, some years later wrote: "When I first saw the Mountain Shrimp walking quietly about in its crystal clear habitation as if nothing of any great consequence had happened since its ancestor walked in a sea peopled with strange reptiles, by a shore on which none but cold-blooded creatures plashed among rank forests of fern-like trees, before ever a bird flew or youngling was suckled with milk, time for me was annihilated and the imposing kingdom of man shrunk indeed to a little measure."

The occasion for the writing of the present note is the arrival at the Natural History Museum of two living specimens of *Anaspides*, the first living representatives of their family in the Northern Hemisphere, so far as we know, since it died out here

in far-off Palæozoic times. These two are the survivors of seven which started on the voyage. They were brought from Mount Wellington on April 2nd and, to compass their safe journeying, it was necessary to take passage on a boat equipped with refrigerating equipment.* The Ranger, Mr. King, kindly secured the specimens notwithstanding the inclement weather—it was at the moment of the breaking of the recent disastrous storm and floods—and they were taken as speedily as possible by motor to Port Huon and put on board the steamship “Banffshire.” As the cooling machinery was not yet in operation, they were placed temporarily in two vessels, in the coolest part of the hold. Of the three specimens in the smaller receptacle one appeared lethargic and next morning was found dead, partly eaten, and covered with a fine fur-like growth of mould, and its two companions were also dead, presumably as a consequence of their cannibalistic feast. Apparently if kept in captivity *Anaspides* is very liable towards autumn to a fungoid disease. To save the remainder, their container was at once placed upon ice, and the writer, accompanied by two lascar deck hands, set off up the mountain side, to a near-by torrent, to secure a supply of unpolluted water. Into some of this in a larger glass vessel, securely packed in insulating material, the four remaining specimens were transferred and placed in one of the freezing chambers. In a little while a thick plug of ice completely sealed the vessel and prevented any movement of the water when the ship tossed during the stormy passage round south-west Tasmania and across the Bight. A quantity of bags covered the jar and prevented freezing going too far, while the balance of the mountain water was frozen solid as a reserve. Three times, at fortnightly intervals during the voyage, a couple of gallons were brought to the melting point, and the specimens transferred to this fresh water, which had previously been thoroughly shaken to insure aeration.

A NEW PEKINGESE DOG, “VERITY MINNI-ATUA.”

By QUEENIE VERITY-STEELE, Author of “The Book on Pekingese.”

THE Chinese legend concerning the origin of the pekingese dog is as follows:—A very noble lion begged Ah Chu, the Chinese patron saint of animals, to give his consent to an

* The writer desires to take this opportunity to express his gratitude to the officers and engineers of the steamship “Banffshire,” particularly to Capt. Westropp, the Chief Engineer, Mr. Grant, and the Second Engineer, Mr. Bowman, for their whole-hearted co-operation in the experiment.

alliance between a small marmoset, with which he was greatly enamoured, and himself. The saint, having considered the matter, replied:

"Yes, on condition that you sacrifice your strength and size for the sake of love." The kingly lion made the sacrifice, giving his heart to the safe-keeping of the tiny monkey. From this love alliance resulted the beginning of the pekingese. We can trace in the eyes of our little Celestial friends the tenderness and beauty of the marmoset, and



FIG. 1.—"AH CUM."
Imported from China, 1896.

both the lion-like mane and dignified carriage look as though derived from the supposed leonine ancestor.

The breed is of great antiquity, and until 1860 no pekingese was ever seen outside the Imperial Palace of China. They are represented in all kinds of Chinese art. The death penalty was inflicted on anyone stealing a dog from the Palace, and any neglect by an attendant meant torture for the unfortunate human being. These dogs were absolutely idolized by the Imperial House of China. It was in 1866 that Admiral Lord John Hay secured specimens during the looting of the Summer Palace, and the first of the breed seen in England were "Schlorff" and a small bitch named "Hytien." These two Lord John Hay gave to his sister, the Duchess of Wellington. "Schlorff" lived



FIG. 2.—"GLANBRANE BOXER."
Imported from Pekin Palace, 1900.

to be an aged dog. When Lord John Hay married in 1876 he was given a dog and a bitch bred by the Duke of Wellington.

From these two animals, "Sara" and "Zin," and the two imported by Admiral Sir William Dowell in 1885, all the pekingese dogs in England have originated. Later imported dogs were "Ch. Goodwood Chun," "Ch. Goodwood Lo," and the one now exhibited in the British Museum (Natural History), "Ah

Cum" (Fig. 1). In 1900, during the time that the troops were outside Pekin Palace in the Boxer riots, the late Major James

Hugh Gwynne, of the 23rd Welsh Fusiliers, was presented at the gates of the Palace by the statesman, Prince Ching, with the dog "Glanbrane Boxer," (Fig. 2), and the bitch "Poongi." Major Gwynne brought the pair to England. "Glanbrane Boxer" was a real lion dog—deep copper-red in colour, of a



Photograph by

FIG. 4.—"VERITY VANDYK."
Weight, 10 lb.

Thos. Fall.



Photograph by

FIG. 3.—"VERITY MACAW."
Weight, 6½ lb.

Thos. Fall.

massive type and with a wonderful head; he has been the very backbone of the dogs of the present day. It is from this dog

that the Verity pekingese were bred. In the picture of "Verity Macaw" (Fig. 3) is seen his direct descendant, in succession the eighth generation; five of these generations have been bred by the writer. Another of the descendants of "Clanbrane Boxer" is "Verity Vandyk," a red and white particoloured dog. In 1915 Mr. Yuh Lin Lew, the Chinese Minister in London, took two of the Verity dogs back to China with him, in order to continue the Boxer strain there. There were, he told me, no longer any real Palace pekingese in China, and he did not think that the dogs to be seen in the streets at that time were pure

bred. The Commissioner of Police in Tientsin had the real Palace dogs, but would not sell one on any account. Mr. Yuh Lin Lew wrote to me afterwards to say that he had not been successful in obtaining any good pekingese dogs bred in China at that time, and that the breed was no longer true to type.



Photograph by

FIG. 5.—"VERITY MINNI-ATUA."

Weight, 5½ lb.

Thos. Fall.

This was his reason for taking my two dogs from England to continue in China the real Palace pekingese.

The size of these dogs has been an endless source of discussion. It is a curious fact that in no other breed of dog is found such a diversity of size, yet all of the same type. The usual size of pekingese is anything from 8 lb. to 12 lb. and, of course, there are some very good dogs of best type still larger. The breed is scheduled at the Kennel Club as a Toy Dog. Surely no human wishes to be burdened with a toy of heavy weight! A dog over 9 lb. is too heavy for the liking of most women. In the Chinese Palaces the dogs were designated "sleeve" dogs when of small size, because they were held in the large sleeves of the ladies' robes. If they had been big dogs such a thing would have been impossible. The sleeve dog to be perfect in type should still have the lion-like look and carry a

mane on his shoulders extending down in front between the legs, which should be short and bent. The front should be wide and broad in proportion to the size of the dog, and the head should also be large. There is no excuse for a sleeve dog not to be as good as his big brothers in general type. In the sleeve dog "Verity Minni-Atua" (Fig. 5), now on exhibition, is seen what is considered by connoisseurs of the breed to be an ideal specimen. He has been described as on the whole the best dog known. This little dog has also a unique record as a sire, his children having found homes all over the world. One marvellous daughter of his weighs under $2\frac{1}{2}$ lb. and is quite a lesson in type and points; she belongs to the wife of Colonel A. J. Bailey. It should be noted that the two necessary and all-important points in our show-type dogs, and, indeed, in all pekingese of real value, are the very short noses, flat on face (monkey-like), and the very short legs, ending in large feet (not round-toed feet like cats). By looking at the model of "Ah Cum," the dog which was brought to England in 1896, it will be seen that the bridge of the nose is much too long for the present-day type, and the legs are too long and thin. "Ah Cum" was claimed to be a sleeve dog in size, but would be far too heavy in these days. A sleeve dog must weigh under 6 lb.

The little fanciful lines written by the Dowager Empress of China about the dogs are as follows :—

Low forehead like a harmony Boxer ;
Spectacles, the mark of learning ;
White star, the celestial spot ;
The mane, to represent the lion of faith ;
The plume, to represent the sacred flames ;
The flat nose, the chief beauty.
They weep tears if grieving ;
They are obstinate at times ;
They are cat-like in suppleness ;
Yellow in colour, like the Imperial Palace yellow.

In studying mounted domesticated animals in museums, allowance should always be made for loss of coat and other small defects. "Verity Minni-Atua" was one of the heaviest coated dogs ever shown, but the dog as now mounted, although so beautiful, has lost a certain amount of its coat.

AN EGYPTIAN CAVE-DWELLING INSECT.

By D. E. KIMMINS, Unofficial Scientific Worker, Department of Entomology.

THE Entomological Department of the British Museum has recently had the good fortune to obtain further specimens of a

very remarkable Neuropteran, *Pterocroce storeyi*, related to the ant-lions and the familiar lacewing-flies of Great Britain. It is

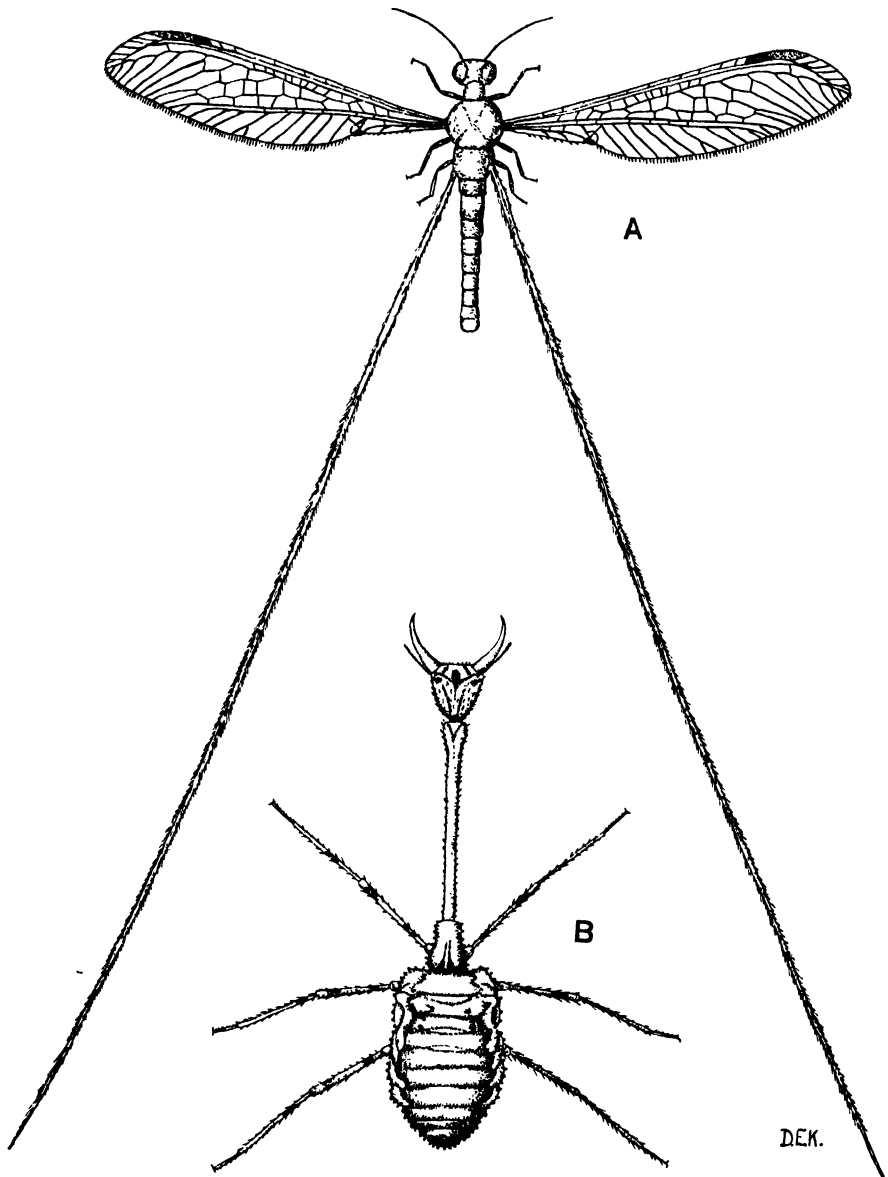


FIG. 1.—*Pterocroce storeyi*.
A. Adult insect. B. Larva.
Greatly enlarged.

a delicately built, four-winged insect, less than one inch in expanse, the fore-wings being transparent and covered with a

network of veins, whilst the hinder pair are thread-like and more than three times as long as the others.

This insect was first bred by the late Mr. G. Storey, who found the larvæ in a desert cave near Cairo. The larva (Fig. 1B) is even more curious and striking than the mature insect. It has a short pear-shaped body, greyish in colour and sparsely covered with tubercles, with six long, slender legs. Its head is carried at the end of a narrow neck, which is about as long as the body. The head is flattened and is broadest at the front. It has no mouth, but on the front of the head are two incurved jaws. These are each really composed of two portions that fit tightly together, and form a tube through which the creature can suck the blood of other insects.

The larvæ live in the very fine dust covering the floors and ledges of caves and tombs in Egypt. The situation most favoured by them seems to be one which is free from wind and sheltered from above in order that the fine dust in which they live may accumulate and remain dry. They are believed to feed on small beetle larvæ, "silver-fish" insects, and other small creatures. The larva is about three-eighths of an inch long when full grown, and the transformation to the pupa (chrysalis) takes place within a cocoon during the summer. The adults (Fig. 1A) fly at dusk during late summer with a peculiar up-and-down motion, the fore-wings being used but the hinder pair trailing behind and taking no part in the flight. The complete life-cycle may take more than twelve months.

These insects belong to the *Nemopteridæ*, the strange development of the hind-wings being a feature of the family. They are not always thread-like; in some forms the hind-wings exhibit a number of paddle-shaped expansions, and have a slight spiral twist towards the tips (Fig. 2). The species of *Nemoptera*, which are to be found in the south of Europe, have streamer-like hind-wings, banded with cream and brown, and the fore-wings are bright yellow with wavy brown markings (Fig. 3).

Very little is known of the larvæ of the other species, but they are believed to live in sheltered places amongst the fine

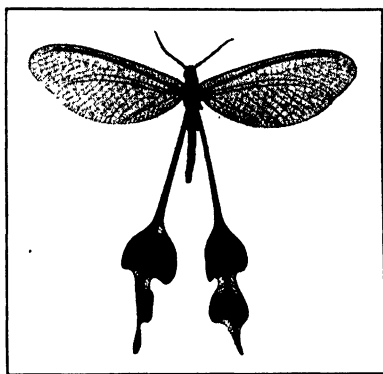


FIG. 2.—*Kirbynia sheppardi*.

ASIA MINOR.

Natural size.

powdery soil, after the manner of ant-lions. The young larva of a Spanish species, *Nemoptera bipennis*, is rather elongate in form, with short stout legs, and lacks the long neck possessed by the larva of *Pterocroce storeyi*. It is possible that, at a late stage in its history, it develops a longer neck. The head is more quadrate and the mandibles are stouter at the base. The whole body is clothed with numerous short bristles, as are the bases of the mandibles.

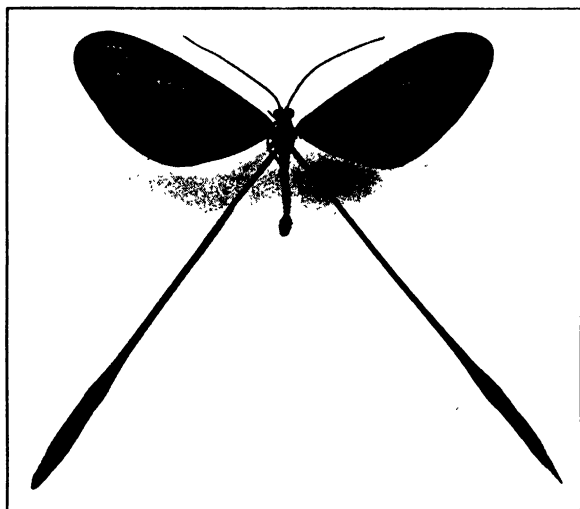


FIG. 3.—*Nemoptera sinuata*.
SOUTHERN EUROPE.
Natural size.

The attention of naturalists visiting the south of Europe is drawn to the scantiness of our knowledge of the earlier stages of these remarkable insects, and further study of their habits should bring to light many interesting facts.

SOME RECORD AND OTHER FINE UNGULATE HEADS IN THE MUSEUM COLLECTION.

By J. GUY DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

AMONG the Museum collection of Ungulates there are many heads which are included in Rowland Ward's "Records of Big Game" (1928); some of them are records, and numerous other specimens are numbered among the first four on the various lists.



FIG. 1.—EAST AFRICAN BUFFALO.

Within the last few months the Museum has acquired by presentation the skull and horns of an exceptionally fine East African Buffalo (*Syncerus caffer radcliffei*) from the Amala River district of the Masai Reserve, Kenya Colony. The specimen (Fig. 1), which is the gift of Mrs. C. M. L. Holmes, was shot by the late Reginald Trayton Holmes in September 1927. The horns of this animal are unusually fine, measuring 53 inches in greatest width (width outside) and 44 inches from tip to tip. The record buffalo head is a specimen owned by Mr. J. Hall, and measures $56\frac{1}{4}$ inches across the horns, with a tip to tip measurement of 44 inches; the next specimen in the 1928 list is given as 53 inches (outside width) and tip to tip measurement of 40 inches. From these figures it is evident that the new Amala River specimen may be considered as a really good example of the species, and will make a handsome addition to the exhibition galleries. Previously the best head in the Museum collection was one from Uganda presented by Mr. T. A. Bowden; the horns in this case measure $48\frac{1}{4}$ inches in width (outside). The third specimen in the 1928 list is one owned by H.M. the King, measuring $52\frac{1}{2}$ inches across the horns and as much as 47 inches from tip to tip.

The typical black buffalo (*Syncerus caffer caffer*) hails from South Africa, the type locality being near Algoa Bay. At one time these beasts were very widely distributed over the whole of South Africa from the Zambesi to the Cape, but disease and the rifle have practically exterminated them in many of their former haunts. The Cape buffalo appears to extend northwards as far as Uganda, Kenya Colony and the Sudan without exhibiting any marked local variation, the specimens from South Africa being frequently quite as large as the East African buffaloes. In Central and West Africa smaller types of buffalo predominate which have been referred to as distinct species, *Syncerus nanus*; these small buffaloes are frequently, but not always, reddish in colour, whereas the large southern and eastern forms are usually black.

Buffaloes are not, as a rule, aggressive, and although a solitary animal may at times display ferocity, members of a herd rarely exhibit any signs of bad temper. But it is well to remember that a buffalo, once roused or injured, is one of the most dangerous of all game animals and will then pursue its antagonist with the utmost determination.

The Museum collection contains no fewer than 127 specimens of Ungulates which are numbered amongst the first four records in the various lists published in the 1928 edition of Rowland



FIG. 2.—SOUTH AFRICAN IMPALA.

Ward's "Records of Big Game"; of these some 55 are first records, and it is hoped from time to time in these pages to draw attention to the more important of these specimens.

One of the most striking of the Museum records is a pair of horns of a South African impala (*Aepyceros melampus melampus*) presented to the Museum about the year 1817 by Dr. W. J. Burchell (Fig. 2). These horns are some $27\frac{1}{2}$ inches in length on the front curve, the straight measurement being 21 inches, and the tip to tip interval $14\frac{1}{4}$ inches. The next best South African impala on the list measures only $24\frac{3}{4}$ inches in length on the front curve, $18\frac{1}{2}$ inches straight, and $5\frac{3}{4}$ inches from tip to tip. The Museum specimen, which was the first example of the species ever received by the Museum, and probably the first in England, was shot in the year 1812 at Lataku, Bechuanaland. The East African impala (*Aepyceros melampus rendilis*) carries much larger horns than its South African cousin, horns of 30 inches and over being by no means rare, whereas the Nyasa (*Aepyceros melampus johnstoni*) and Angolan (*Aepyceros melampus petersi*) races bear horns of about the same size as the typical impala.

Another interesting record in the collection is the skull of a Nilgiri tahr (*Hemitragus hylocrius*) from the Nilgiri Hills, Southern India. This specimen (Fig. 3), which was amongst the large collection bequeathed to the Museum by Mr. A. O. Hume, C.B., carries horns which measure $16\frac{3}{4}$ inches on the front curve, $8\frac{7}{8}$ inches in circumference and $5\frac{5}{8}$ inches from tip to tip. The Nilgiri tahr is the animal erroneously referred to by sportsmen as the Nilgiri "Ibex"; it bears, of course, no close relationship to the ibexes but is nearly related to the Himalayan tahr (*Hemitragus jemlahicus*) and the Arabian tahr (*Hemitragus jayakari*).

One of the most interesting records in the Museum is the pair of horns of an Indian buffalo (*Bubalus bubalis macroceros*) which formerly formed part of Sir Hans Sloane's collections, and were described by him in the *Philosophical Transactions of the Royal Society* for 1727. These horns (Fig. 4) were discovered by a Mr. Doyle in a cellar in Wapping, and the finder gave them to Sir Hans Sloane as a reward for his kindness in attending him in sickness. The horns, which are mounted on an imitation frontlet, each measure some $77\frac{3}{8}$ inches in length and are the largest specimens of their kind. These very long-horned buffaloes, as a rule, are inhabitants of Assam. A specimen from Central Assam, presented by Colonel J. Mathie in 1855, is another very large example, the horns measuring $65\frac{3}{4}$ inches in length. A still larger specimen in the Museum collection is one



FIG. 3.—NILGIRI TAHR.

shot by the late Mr. A. Forbes, the horns of which measure 71 inches in length and are second on the list of records. This latter specimen, also from Assam, more resembles the typical race in the form of the horns, which, instead of being directed for the greater part of their length almost straight out from the head, curve regularly up in a crescentic manner.

AN ECHO OF THE GREAT EXHIBITION.

By W. D. LANG, M.A., Sc.D., F.R.S., Keeper, Department of Geology.

ON the demolition of some old and useless drawers, which were once fitted against the walls of Study D in the basement of the Geological Department, the following inscription in pencil was found on the bottom of one, almost certainly showing that the drawers had originally been used in the Great Exhibition of 1851.

HURRAH FOR THE EXHIBITION.

BILLY NUTS.

MADE BY CHARLES MEAKING, TEETOTALLER,

BILLY JARVIS, THE BOY AND MAN.

CATT THE POET.

THIS CASE IS DONE TO OLD BODY

AN APPEAL.

FELLOW WORKMEN [DON'T] GET DRUNK.

ALONE IN THE EXTRAORDINARY YEAR 1851.

If this were so, it would be of interest to know their subsequent history. After the Great Exhibition, were the drawers moved to Bloomsbury, and did they migrate with the Natural History Collections to this building? Or, more likely, were they stored in the neighbourhood and used again in the later Exhibition on this site?

It is to be hoped that the appeal had its desired effect, and that clear heads celebrated the extraordinary year.

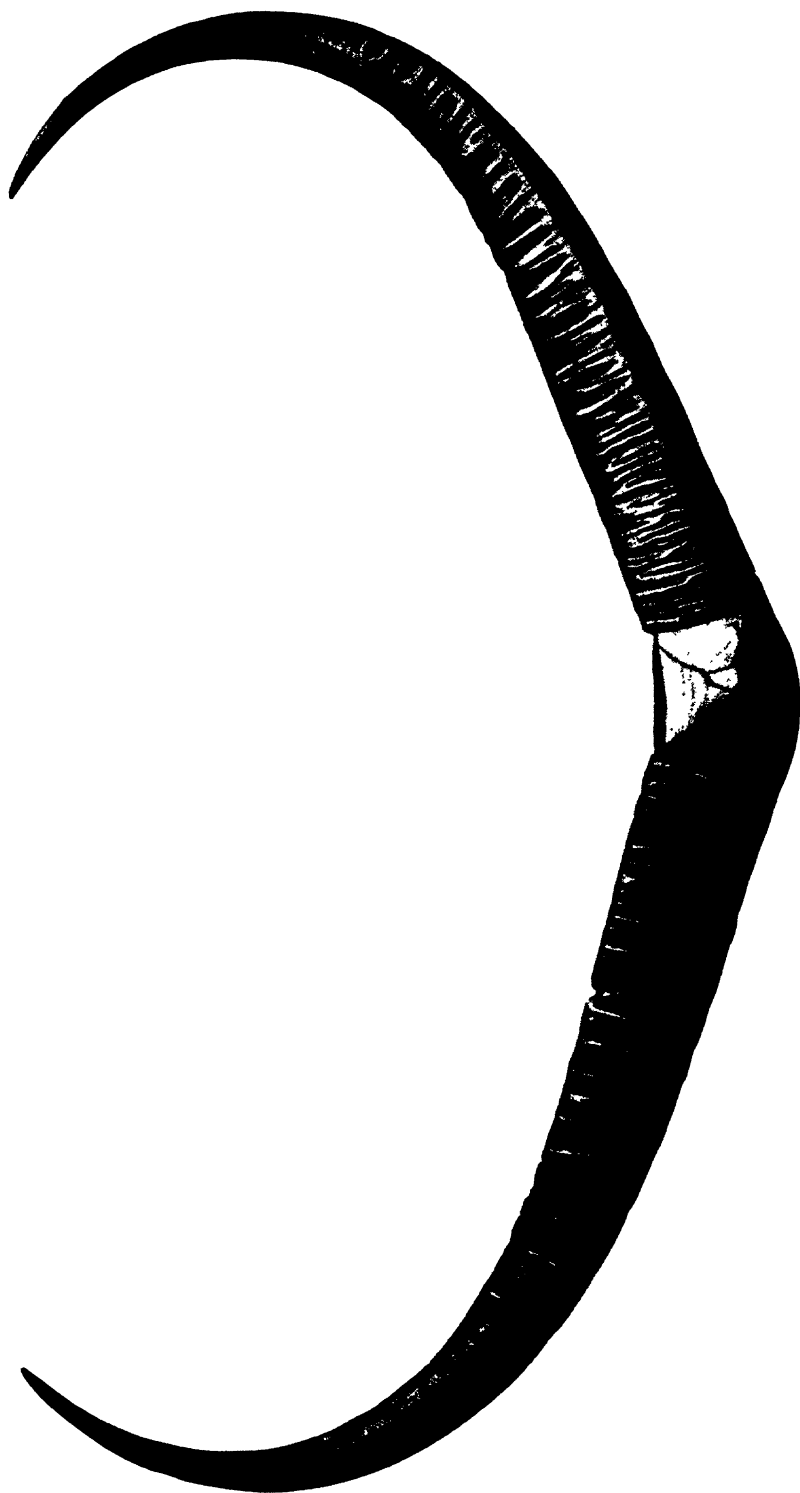


FIG. 4.—INDIAN BUFFALO.

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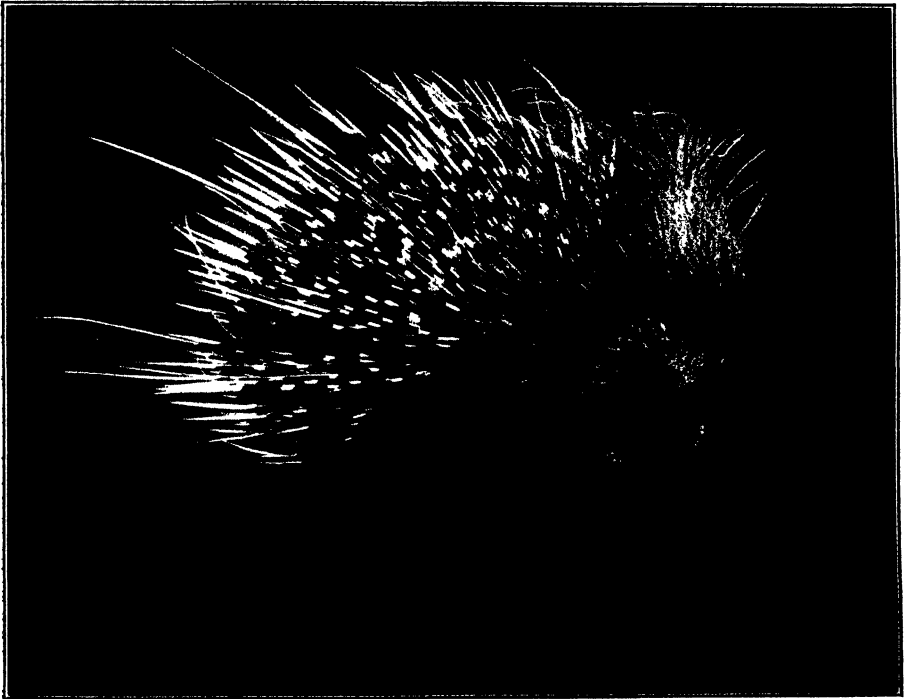
JANUARY, 1930

Vol. II

A NEW SPECIMEN OF THE COMMON PORCUPINE.

By J. G. DOLLMAN, Assistant Keeper, Department of Zoology.

THE Trustees of the British Museum have recently received, as a donation from the Trustees of the Rowland Ward Bequest, a fine specimen of the common porcupine (*Hystrix cristata*), mounted in an attitude of defence with the spines erected.



COMMON PORCUPINE (*Hystrix cristata*).

Porcupines are distinguished from the allied rodents by the spiny nature of the coat and the inflated condition of the frontal region of the skull. The members of this group are distributed throughout the warmer portions of the Old World, with the exception of Madagascar, Australia, and the outlying portions of the Malay Archipelago; in Europe porcupines are only found

in the Mediterranean region. Other types of porcupines inhabit North and South America; in the latter country there are a number of species which possess prehensile tails. These prehensile-tailed porcupines are arboreal in their habits, whereas the short-tailed porcupines, like the common species, are entirely terrestrial. The common porcupine is distributed over a considerable part of northern Africa, central and southern Italy, and Sicily. Reports of porcupines inhabiting the Iberian Peninsula have been received from time to time, but there seems to be no doubt that these reports have been founded on error. The porcupine is fairly common in Italy, where it lives in burrows or among rocks, and is frequently eaten by the natives. The species is remarkable for the very marked inflation of the frontal region, the nasal cavity being immense. The food of these animals consists chiefly of roots, although, in cultivated districts, they will devour vegetables and fruit. The young are born in a carefully lined nest, from two to four at a birth, and their spines, though soft and flexible, are well-formed. Closely allied to the common porcupine is the African species (*Hystrix africae-australis*), a species which is found throughout the greater part of central and southern Africa. Both these forms have the quills of considerable length and differ in this respect from the tree-porcupines of South America, in which the bristles are all short. There is no truth whatever in the old belief that a porcupine can shoot out its quills; its means of defence are limited to the erection of the quills, which, as seen in the photograph here reproduced, are sufficiently formidable to protect the animal from nearly all its enemies. Lions occasionally manage to kill and devour porcupines, but cases are on record of these large carnivora being rendered blind owing to injuries caused by the quills.

The specimen figured was mounted in the studios of Rowland Ward, Limited, London.

A REMARKABLE PARASITIC WORM.

By J. WATERSTON, M.A., D.Sc., Assistant Keeper, Department of Entomology,
and H. A. BAYLIS, M.A., D.Sc., Assistant Keeper, Department of Zoology.

THE curious worm which is the subject of the present note was received at the Museum in September, 1928, from a correspondent in Somerset, Mr. H. G. Filtness. The circumstances of

its capture were as follows. While filling a can with water from a small stream in his garden, the writer noticed an unusually large wasp—a queen—fall into a pool at his side. On securing the wasp he detected a piece of “whitish matter,” about three-eighths of an inch long, hanging from the hind-body of the insect. The wasp was killed by crushing, in which process the “whitish body” grew longer, and on being finally detached appeared as a live worm. So unusual did these facts seem that, in recording them, the writer felt constrained to add, “this statement is perfectly true.” The assurance was unnecessary, for the story is obviously true, and our only wish would be to congratulate the observer upon the accuracy of his account of what took place.

The wasp proves to be *Vespa vulgaris*. The most striking feature of the parasite is its thickness and large size in comparison with its host. The present specimen measures 85 millimetres (about $3\frac{1}{4}$ inches) in length and over 1 millimetre in thickness. The unusual thickness, as compared with related forms, was doubtless in the mind of von Linstow, the original describer of the species, when he named it *Mermis pachysoma*. This was in 1905, when the German author described four specimens sent to him by the late Sir Arthur Shipley. These came from the other common species of wasp, *Vespa germanica*, and were presumably of British origin. Like the present specimen, they were quite immature. Three similar specimens were sent to this Museum in 1922 by Mr. R. Stenton. These had also been obtained in this country, from queen wasps of the same species. Von Linstow does not state whether his wasps were queens, but this was most probably the case.

Nothing is known as to the life-history of this worm, but some idea of its nature may be gathered from what is known of other species. The “blackish” threadworm (*Mermis nigrescens*) is common and widely distributed, and may occasionally be found even in a London garden. This creature, which reaches a length of some five inches or more, with a thickness a little greater than that of a horsehair, is frequently noticed during the summer months, after heavy showers and especially in thundery weather. Sometimes it occurs in considerable numbers, and while occasionally seen in or on the soil, more often attracts attention by its habit of climbing on to rain-washed plants. How and why does it get there, and what is its previous history?

Mermis nigrescens passes its early life, like *Mermis pachysoma*, in the body of some insect, and on the death of its host, or shortly before, escapes to the ground by rupturing the body-wall.

On leaving its host the worm is by no means adult, and a considerable time (perhaps as much as two years) has to be spent in the soil before mating takes place. The males remain always underground, but the females, when ready to lay their eggs, and when the conditions are suitable, climb on to plants, their ascent being probably assisted by the superficial film of rain-water. The sudden drenching of the ground by heavy rain seems to provide the stimulus which causes the worm to climb and begin egg-laying. The eggs of this species are provided with root-like appendages for attachment to the surface on which they are deposited—usually the leaves of a plant. From observations which have been made on a very closely related, if not identical, species in America, it may be regarded as certain that the normal



QUEEN WASP (*Vespa vulgaris*) AND ITS RECENTLY-EMERGED PARASITE (*Mermis pachysoma*).

fate of these eggs is to be swallowed by some insect which feeds on the leaves. The hosts in which both forms have been definitely observed to develop are grasshoppers. As, however, these are not common inhabitants of suburban gardens in this country, it seems highly probable that other leaf-eating insects, such as the caterpillars of Lepidoptera, also act as hosts for *Mermis nigrescens*. The egg-shell splits into two halves after an hour or so in the stomach of the insect, and the contained larval worm bores its way through the wall of the alimentary canal into the body-cavity, where it grows rapidly, reaching almost the adult size in the course of the summer and autumn.

The eggs of other species of *Mermis* are laid in the soil or in water, where they hatch spontaneously, and the larvæ penetrate by their own efforts through the skin of suitable insect hosts. In one form which has recently been studied in America, the anterior sixth part only of the length of the larva enters the host, the remaining five-sixths breaking off at a preformed "node," and being left behind. A species (*Mermis myrmecophila*) described by Crawley and Baylis in 1921 invades the females

only of certain species of ants, and produces in them not only a marked stunting of the wings, so that flight is impossible, but also degeneration of the ovaries, hypertrophy of the tracheæ, and absorption of the fat-body. In this species it is almost certain that the infection of the ants takes place during their larval period, though this fact has not been actually observed. Emergence from the ant takes place in July, and the worm then lives in the soil for six or seven months before becoming mature. To this ant-parasite *Mermis pachysoma* of wasps appears to be very closely related, and its life-history might be expected to be similar. It is, of course, possible that the queen wasp becomes infected after assuming an independent life, but, as no queen taken in September is likely to be a month old, it may be doubted whether this would allow sufficient time for the development of the worm. We must assume therefore that infection takes place within the nest, and probably during the grub stage. It may be that workers and males are similarly attacked, but their short subsequent life and smaller size may inhibit in some way the development of the worm.

How then are the wasp grubs infected? It must be remembered that the nest is deserted in the autumn, and is not revisited, so that grubs are not present all the year round as in the case of the ants. It is interesting to speculate on the possible means by which infective eggs or larvæ may be introduced into the nest during the summer period of activity. One possibility is that food such as the chewed-up and regurgitated insects, particularly small caterpillars, which form a staple diet of wasp grubs, may have been previously infected. Frankly, however, we must confess that we do not know, and one of our objects in writing this note is to appeal to all who may be interested to make further observations. The frequency of infection at least should be ascertainable, since large numbers of queen wasps are hunted for and destroyed every autumn. We should welcome the sending of any infected specimens, if fresh, for study. If the worm itself be forwarded, moisture should be supplied in the shape of damp earth, moss, or even cotton wool.

WITH THE BRITISH ASSOCIATION IN SOUTH AFRICA.

By A. B. RENDLE, M.A., D.Sc., F.R.S., Keeper, Department of Botany.

MEMBERS of the Staffs of the Departments of Botany, Geology, and Mineralogy attended the meeting of the British Association in South Africa in July and August last. The meetings took place at Cape Town and Johannesburg, after which the members dispersed on various official or private excursions and returned home by different routes. The following notes record some impressions of a botanist.



FIG. 1.—*Euphorbia canariensis*, SHOWING THE ERECT FLUTED CANDELABRA-LIKE GROWTH.

A large contingent travelled out by the Union-Castle liner "Llandovery Castle," which called en route at Teneriffe, Ascension, and St. Helena, and some hours were spent ashore at the first and last of these islands.

Much of the vegetation of Teneriffe, especially between the port, Santa Cruz, and La Laguna, the old Spanish capital of the Island, is introduced. We passed plantations of banana, maize, and prickly pear (formerly extensively grown as a host-plant for the cochineal insect), and drove through a very fine avenue of eucalyptus on our way to the Mercedes forest, which rises to 3200 ft. in the centre of the island. The road winds up through woodland with dense undergrowth, and fine views are obtainable

down the valleys to the sea, which is framed by tall brownish cliffs the slopes of which are dotted with the slender light-green fluted candelabra of *Euphorbia canariensis* (Fig. 1). At about 3000 ft. we alight and wander through a low forest of laurel and heather and stunted specimens of the native pine (*Pinus canariensis*). The great botanical feature of the island is the Dragon Tree (*Dracaena Draco*), the most remarkable arborescent member of the lily family (Fig. 2), scattered specimens of which occur throughout the island. The trees reach a great age and have a peculiar habit—a short stout stem repeatedly branching



[Photograph by Prof. Marie Victorin.]

FIG. 2.—LEFT, DRAGON-TREE (*Dracaena Draco*) OF TENERIFFE.
RIGHT, NATIVE PALM (*Phoenix canariensis*).

to form a thick bushy crown bearing long stiff slender sword-like leaves.

Ascension viewed from the sea is a collection of barren volcanic cones. The island is part of a large crater, half of which has been washed away; a number of later volcanic outbreaks have formed pyramidal cones of various sizes, mostly quite bare and reddish in colour, suggesting slag-heaps. The higher peaks are green above, and the lowest shelters a wooded basin, where are some cultivation and a small farm which serves as a sanatorium for the small population (barely 300) of Georgetown, mainly the employees of the Eastern Telegraph Co., whose signal station dominates the little town. A sandy beach is frequented by turtle which come to lay their eggs, and near by is an artificial turtle pond. At the south end of the island are guano deposits

giving a grey-white appearance to the low cliffs. Landing is only possible from surf-boats, and we were not allowed ashore as, although the day was fine, Atlantic rollers might come up suddenly and make it impossible to get back to the ship.

St. Helena, when discovered by the Portuguese in 1501, was said to be covered with forest to the cliff-edge, but the introduction of goats and the extravagant felling for fuel and timber by the early settlers, played havoc with the forests, which included two valuable endemic trees, an ebony and a redwood,



FIG. 3.—*Podocarpus elongata* IN THE PLANTATIONS, ST. HELENA.

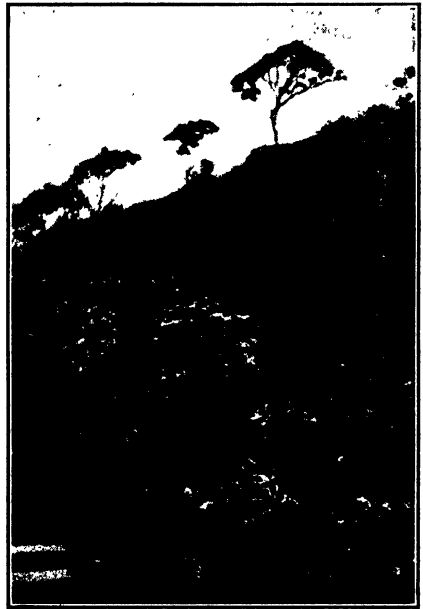


FIG. 4.—TREE COMPOSITE (*Commidendron robustum*) ON THE HIGH RIDGES.

species of *Melhaniania*. Later when the island had become a station of the Honourable East India Company, the destruction of the native vegetation was accelerated by the introduction of plants for use and ornament by Governor Beatson from many parts of the world. To-day it presents a remarkable mixture of alien vegetation. Eucalyptus and acacia are frequent along the road up to the plateau. The South European *Pinus Pinaster* is common on the higher land, and the Stone pine and Canary Island pine also occur. Fine specimens of the Cape yew (*Podocarpus elongata*) (Fig. 3) and Norfolk Island pine (*Araucaria excelsa*) grow along with many other introductions in the Plantations, an extensive wooded area at mid-altitude, in which

is the Governor's House (Fig. 5). The dandelion of the island is our Cat's Ear (*Hypochaeris radicata*); the common blackberry is a species from Madeira (*Rubus pinnatus*), and herbaceous species from the Cape and Australia are more or less of pests in cultivated ground. Comparatively little now remains of the original flora except in the high ridges in the centre of the island. Its destruction is especially to be regretted, as our limited knowledge shows it to have been remarkably interesting. There was a large proportion of endemics, including several genera of arborescent



FIG. 5.—VIEW IN THE PLANTATIONS, SHOWING GOVERNOR'S HOUSE, ST. HELENA.

composites, individual specimens or small groups of which still linger on the higher ridges (Fig. 4).

New Zealand flax (*Phormium tenax*) is extensively cultivated and there is a local lace industry. Much damage is caused on the island by termites; at the time of our visit the Governor's House had been gutted of all the woodwork from floor to roof owing to their depredations (Fig. 6).

It is still winter on our arrival in Cape Town, though the days are sunny and warm; and the season is early for botanizing, but there is plenty of interest. The *Proteas* are in full flower and also a fair proportion of the numerous species of Cape Heaths; but comparatively few of the bulbous plants which are a feature

of the Cape flora, and we are too early for the great variety of terrestrial orchids.

A day on the Cape Peninsula finishing at the Cape of Good Hope yields a good harvest. From the Cape of Good Hope a fine view is obtained of Cape Point; the cliff rises to 800 ft. and is crowned by a lighthouse (Figs. 7, 8).

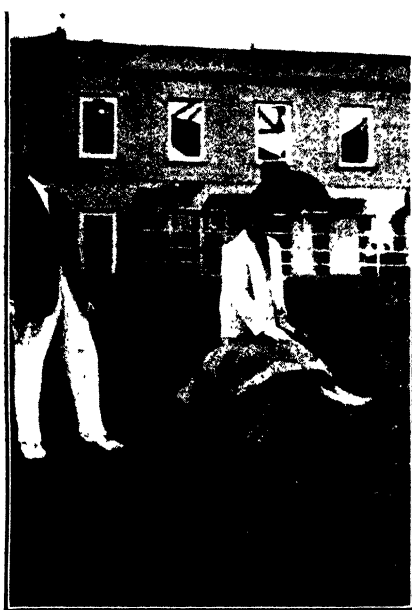


FIG. 6.—THE FAMOUS TORTOISE, TWO-HUNDRED YEARS OR MORE OLD. BEHIND IS THE GOVERNOR'S HOUSE, WITH WOODWORK REMOVED OWING TO DEPREDATION BY TERMITES. ST. HELENA.

One of the sights of Cape Town is the morning flower-market in the main street (Ad-derley St.), where a brilliant display of flowers in season is on sale. Indiscriminate and reckless picking of wild flowers for sale and for local flower-shows threatens the extermination of some of the rarer or more beautiful species. An attempt to obviate this has been made by the Government by scheduling these as "protected." A large part of the wonderful National Botanic Gardens at Kirstenbosch on the eastern slopes of Table Mountain (comprising about 1200 acres) is set apart as a Nature Reserve of indigenous mixed forest and scrub, and includes a number of specimens of the beautiful Silver Tree, one of the rapidly disappearing species. The new University buildings at Rondebosch, where the sectional

meetings of the British Association were held, are also on the lower slope of the great mountain which dominates Cape Town and its environs. Just above the University is the Rhodes Memorial, from which there is a wonderful view across the Cape Flats for twenty miles to the Hottentot's Holland range of mountains. The open vegetation of these flats is gradually being transformed by the spread of the "Port Jackson Willow" (*Acacia saligna*), an introduction from Australia which is becoming dominant.

The forests of the George and Knysna districts contrast with the more open dry-country flora of the Cape Peninsula. Deep forest-clad valleys run from the foot-hills of the Outeniqua

Mountains to the coast, and present to the European botanist a bewildering variety of tree-species, including some good timber trees (Figs. 9, 10). The Union Government is taking active steps for their preservation, and is also reafforesting large areas with quick-growing soft woods—species of *Pinus* from the northern hemisphere.

The journey from Johannesburg, after the meetings, through Southern Rhodesia by Bulawayo to the Victoria Falls and thence via Fort Victoria and Salisbury to the coast at Beira, allowed

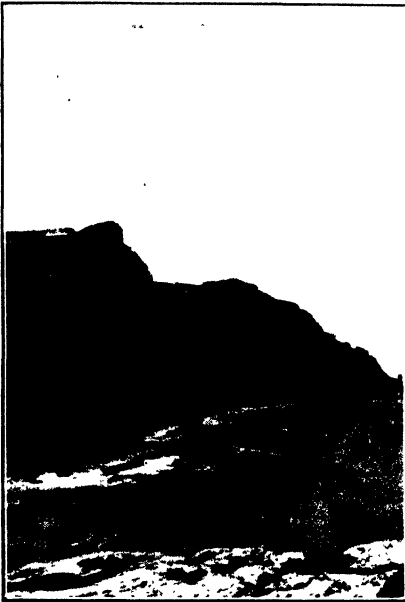


FIG. 7.—CAPE POINT, WITH LIGHTHOUSE, THE EXTREME END OF CAPE PENINSULA.

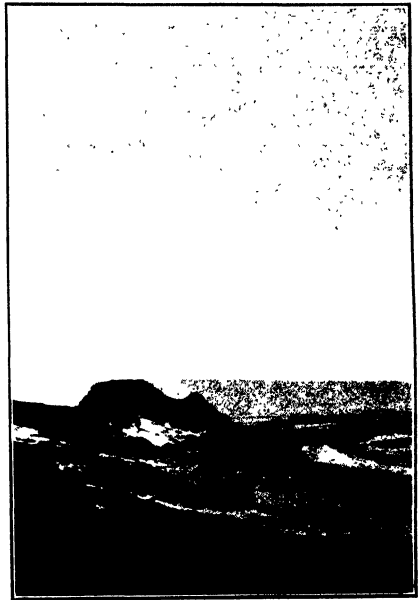


FIG. 8.—CAPE OF GOOD HOPE, EXTREME END, WHERE THE ATLANTIC AND INDIAN OCEANS MEET.

glimpses of very different types of vegetation. The tropical luxuriance of the vegetation at the Falls and on the banks of the Zambesi contrasts with the dry veld country near Fort Victoria. About a mile above the Falls are a number of "Big Trees," large Baobabs (*Adansonia digitata*) (Fig. 11), remarkably sturdy looking with their huge smooth blue-grey trunks and much-branched crown, leafless in August, but bearing great pendulous sausage-shaped fruits. A trip by motor-launch ten miles up the river to Kandahar Island is full of interest. The numerous green islands above the Falls are fringed with the tall graceful Papyrus. The banks are lined with mixed forest, above the general level of which project the feathery crowns of two species

of palms, a *Cocos*, and a *Hyphaene*, the former allied to the coco-nut, the latter to the Doum palm of the Sudan, and like it bearing a fruit about the size of a fist, with a fibrous outer coat and a hard seed which forms a substitute for ivory. Our steersman finds the fruits handy for rousing a crocodile which is dozing on a flat rock; the beast blinks lazily and sleeps on!



FIG. 9.—KAIMAN'S GHAT, NEAR GEORGE;
GORGE NEAR MOUTH OF RIVER.

Perhaps the most interesting spot at the Falls is Livingstone Island, near the centre of the main fall and at the extreme edge. At the cost of getting drenched with spray thrilling views of the fall are obtained from the overhanging trees at the edge of the island. It was from here that Livingstone first saw the Falls in 1855, thus ending his search for the "sounding smoke," the interpretation of the native name, of which he had often heard. This small island is covered with vegetation, and the water-logged green sward on the side near the Falls yielded several minute but interesting species. The trip from the river bank is made in native canoes, which glide through smooth water among beautiful little islands, a remarkable contrast with the tremendous happenings a few hundred yards below. Just below the Falls where the great volume of water enters the narrow sharply-winding gorge the edge of the cliffs is scooped out into a steep bay—the Palm Grove. The sides are densely clothed with tropical forest-growth; the trees, of many species, struggle for light and air and are knit by festoons of great woody climbers or lianes; long-tailed baboons swing in the branches. A steep rocky track leads down to the "boiling pot" at the bottom, where the waters roar and surge as they enter the deep channel of the gorge.

Fort Victoria, the first permanent European settlement in Southern Rhodesia, is five miles from the fort built by the

Pioneer Column when they entered the plains through the pass in the hills in 1890. About fifteen miles away, overlooking the open country and at the entrance to a romantically wild district of granitic hills, are the Zimbabwe Ruins, the relic of an earlier race endowed with architectural and engineering skill vastly superior to that of the present-day Bantu native. The origin and meaning of the Acropolis, which crowns a lofty hill, and the Temple in the valley below, are matter for dispute among

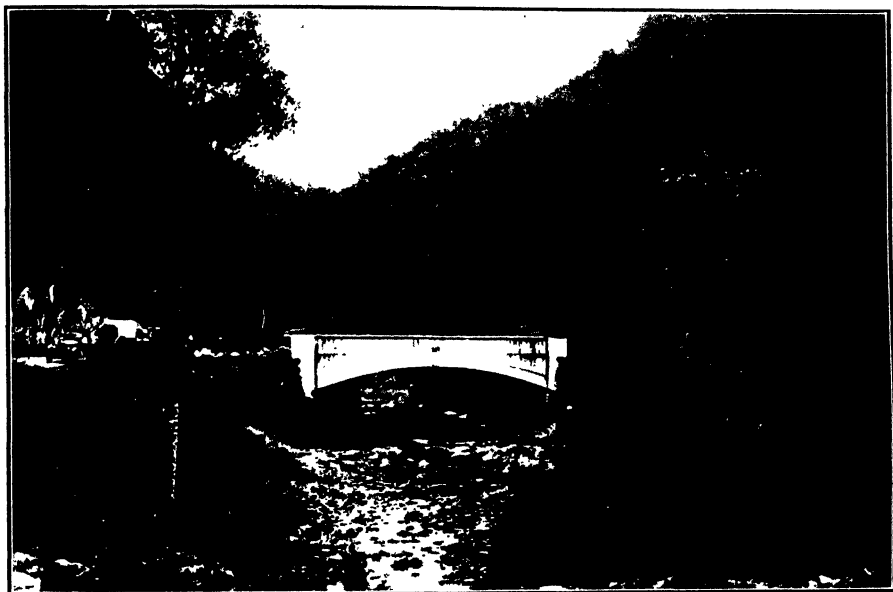


FIG. 10.—WOODED VALLEY ON TROUW RIVER, KNYSNA DISTRICT.

archaeologists. The mere botanist admires and wonders at the skill which could raise from roughly squared granite blocks such perfect walls and approaches, combining them skilfully with the natural rock, without the use of any kind of mortar (Fig. 12). The valley of the Chibopopo river a few miles away is a good hunting ground; the huge boulders near the picturesque falls are draped with creepers and climbers, the crannies shelter unfamiliar ferns, and the flat swamp-land through which the river winds below the falls yields interesting marsh plants, including several minute species of bladderwort (*Utricularia*) (Fig. 13). A striking feature of the more open country is the Kaffir orange (*Strychnos spinosa*); the trees are now leafless, but the fruits hang from the branches like small green cannon-balls.

The last stage of the train journey from Salisbury to Beira

passes through very romantic mountainous country; the track winds round great hills crowned by fantastic-looking boulders. Umtali, reached at nightfall, is very beautifully situated. Through the night we drop several thousand feet from the great South African tableland, and at dawn are passing through the flat coast-belt with palm groves, cotton plantations and later, sandy flats, to Beira. In a mangrove-swamp just outside that town the botanists may see in real life the manner of growth of these remarkable trees. Well-developed seedlings are dropped

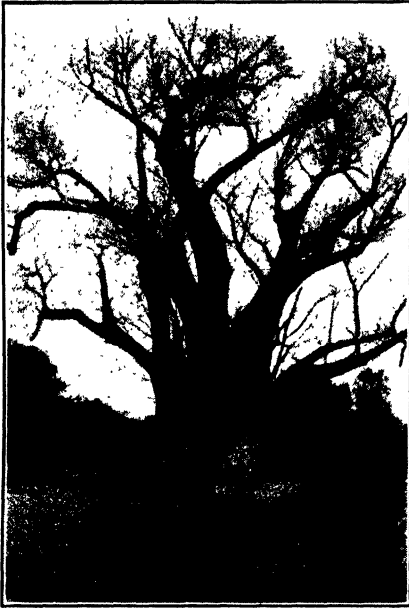


FIG. 11.—BAOBAB (*Adansonia digitata*)
NEAR VICTORIA FALLS.



FIG. 12.—VIEW IN TEMPLE ENCLOSURE,
ZIMBABWE. WALL IN BACKGROUND
SHOWS MANNER OF BUILDING.

from the fruit which persists on the tree; the heavy pointed root of the seedling ensures its penetrating the mud, and a pair of spreading green leaves enables it to start life straight away.

The few days at sea in warm sunny weather, from Beira to Zanzibar, are very restful after the train life and sight-seeing in Rhodesia. At Zanzibar we are received by the Sultan, who entertains the party of one hundred to lunch in the grounds of an old palace, now in ruins, at Dunga some ten miles inland. The drive to Dunga passes through miles of clove-plantations. The Clove (*Eugenia caryophyllata*) is a densely leaved tree of

medium size, and may go on bearing for a hundred years. The "clove" is the unopened flower-bud, and the picking is done by hand, the natives climbing the trees for the purpose (Fig. 14). The buds are spread to dry in the sun on cement floors or grass-mats. Cloves are the premier industry of the Protectorate; the total number of trees in the two islands of Zanzibar and Pemba is estimated at $3\frac{1}{2}$ millions. The plant is a native of the Moluccas, and was introduced to Zanzibar from Mauritius at the end of the eighteenth century. Recently coco-nut has been extensively planted in the poorer lands, and there is now a large export trade in copra, the dried meat of the nut (Fig. 15).

The drive of about 25 miles across the island from Zanzibar to Chwaka on the Indian Ocean is very picturesque. The road traverses a succession of ridges and valleys, and the latter, thickly planted with coco-nut, present a sea of feathery palm-crowns when viewed from the higher land.

The new Museum (Fig. 16), erected as a Peace Memorial, is under the charge of Dr. Spurrier, who has lived for many years in the island, formerly as Medical Officer of Health. He was a very kind guide and host during the two delightful days that I spent in Zanzibar. The Museum is a well-arranged exposition of the ethnology, natural history and industries of the island; and a useful series of handbooks has been prepared.

The climate of Zanzibar, though warm, is very pleasant in August, and one would fain linger to botanize in the valleys of the interior and along the shore of the Indian Ocean, or to wander again through the fruit-market with its display of tropical fruits or in the bewildering maze of the old Arab town with its interesting mixed population of Arab, African and Indian. But s.s. "Khandalla" is waiting for us in the harbour.

It is less than twelve hours' sail from Zanzibar to Mombasa,



FIG. 13.—MASSSED BOULDERS, NEAR FALLS ON CHIBOPOPO RIVER.

where we entrain for Nairobi, the capital of Kenya Colony—a journey of eighteen hours. The route traverses the great game reserve, where zebra, hartebeest, wildebeest, gazelle, ostriches, and other examples of the native fauna may be seen quietly grazing or roaming, singly or in herds. Nairobi is 5500 feet above sea-level, and beyond it the land rises still higher to the great escarpment overlooking the Rift Valley. The hill-country supports many coffee-plantations, also plantations of tea and

sisal-hemp (*Agave sisalana*), dairy-farms and tannin-factories. Mealy-bug is the worst enemy of the coffee, and at the Scott Laboratories, to which a visit was paid, lady-birds were being bred to combat the pest. The sisal, we were told, has no enemies, and is an easy crop to grow; lateral shoots are broken from the basal stock and merely stuck in the ground, where they take root without further trouble.

The botanists of the party were able to visit the forest-belt on Mt. Kenya under the guidance of Mr. Gardner, Conservator of Forests. The slopes of the mountain from about 5500 to 12,000 feet are clothed with magnificent forests, the constituents of which vary on the different aspects. The most striking is the conifer forest, near Nanyuki, where the Equator cuts the mountain.



FIG. 14:—NATIVES PICKING CLOVES,
ZANZIBAR.

Here are almost pure stands of the Kenya “cedar”—a species of juniper (*Juniperus procera*), and also mixed woods of cedar and podocarp (*Podocarpus milanji*ana, originally described by the writer from Mt. Milanji in Nyasaland, and *P. gracilior*). The cedar is the most abundant and valuable timber-tree of the Colony, and the two podocarps constitute the chief soft wood, being generally used as a substitute for deal. The largest tree of the Colony is the “camphor” (*Ocotea usambarensis*, Laurel family), which reaches a height of 120 feet with a diameter up to 10 feet.



FIG. 15.—COCO-NUT PALMS IN NATIVE TOWN, ZANZIBAR.



FIG. 16.—NEW MUSEUM, ZANZIBAR.

Some very fine specimens were seen in the Camphor forest on the eastern slopes of the mountain.

A lecture on preservation of natural flora given by the writer at Nyeri, a beautifully situated hill-station near the foot of the mountain, had a gratifying result, several of the influential townsfolk expressing a determination to move for the conservation of the remarkable flora of Mt. Kenya.

Eight days later we are back again at Mombasa, where we embark for home on the British India Steam Navigation Company's ship "Matiana," and reach Marseilles after a pleasant and restful but uneventful sea-trip.

THE STORY OF THE NANDI BEAR.

By R. I. Pocock, F.R.S., Unofficial Scientific Worker, Department of Zoology.

DURING the past ten years stories about an unidentified predatory beast, known as the "Nandi Bear," have been sent home by game wardens and sportsmen from East African territories under British jurisdiction. These stories admittedly rested to a great extent upon information supplied by natives, who held the beast in the utmost horror. One of its alleged peculiarities was the habit of standing upon its hind legs, and this allegation probably explains the belief that it was akin to a bear or possibly an anthropoid ape unusually ferocious in character.

The first evidence, other than hearsay reports, of the existence of this creature that came to my notice was sent to the *Field* newspaper some years ago by the game warden of Kenya Colony. This was a sketch, made by a veterinary surgeon, of its footprint showing the impression of six toe-pads. But since a pentadactyle paw is a heritage handed down to the reptiles and mammals of our time through millions of generations from the dawn of quadrupedal life, no zoologist will admit the normal occurrence of a sixth digit in any vertebrated animal unless the evidence in its favour is strong enough to compel belief. Nevertheless, the presence of six toe-pads in the foot-track of this "Nandi Bear" was cited, not as a surprising phenomenon, but as cogent evidence of the reality of this strange, unclassified animal.

To anyone acquainted with the structure of the feet of

mammals, it was clear that the sketch in question represented the four-toed impression of a hyæna's foot with the marks of two toe-pads of another foot of the same animal superadded; it was a composite track. This was the verdict I gave at the time; but the necessity for its repetition is shown by a warning recently conveyed to the zoological staff of the British Museum that the appearance of six toes in a hyæna's skin forwarded to that institution was due to the bisection of the plantar pad which, when the skin was flattened, brought two toe-like projections, an outer and an inner, into serial alignment with the four normal digits.

The next item of evidence to come to hand regarding this supposedly unknown beast was more tangible and more satisfactorily dealt with. It was an entire skin sent to the Museum as a curiosity from Nyasaland by a man who, without professing to know anything of natural history, said he had been told it was a Nandi Bear's. It was a spotted hyæna's, not normal in colour but red, an erythristic mutant; and this was no doubt the reason why it was regarded as something strange and valuable. These red varieties are interesting and seem to be commoner in more arid districts farther north, *i.e.* in Somaliland and the Sudan, than they are in the British East African Protectorates.

In the summer and autumn of this year considerable correspondence relating to this "alleged unknown beast," this "mysterious hyæna-like" animal, passed between the Zoological Department of the British Museum and two of the most valuable contributors to the national collection, Capt. J. E. Tracy Philipps, District Commissioner of the Ruanda Protectorate, and Capt. C. R. S. Pitman, Game Warden of Uganda, who have taken the greatest interest in this reputed beast and have spared no pains in their efforts to find the source of the belief in it held by the natives.

Capt. Philipps sent the specimens he secured to the Museum; and Capt. Pitman received from other sources additional material which he also sent to the Museum. Copious notes accompanied the specimens, and the Keeper of the Zoological Department has requested me to summarize the results so far obtained. The notes are for the most part too long to quote in full, but I have extracted the most interesting items of information they contain.

"Sabrūkū." At the end of May, Capt. Pitman reported that Mr. G. W. Foster, Honorary Game Ranger, had heard of the existence on Mt. Elgon of a "strange and fearsome beast"

known to the Bagishu and Sabai as the Sabrukū. "This creature appeared to be akin to the Nandi Bear in which the local natives believed and of which they were thoroughly afraid." Mr. Foster secured the skin of a young animal killed at 8000 feet on the mountain; also the skull and greater part of the skeleton of an adult specimen. This skull Capt. Pitman quite correctly identified as that of a spotted hyæna; but the skin apparently puzzled him and Mr. Foster. Its coat is long and shaggy, the colour is blackish, mottled and clouded with white on the body, fading gradually over the withers and nape into dirty white on the face, and passing into uniform blackish-brown on the belly and legs. This was correctly determined by Miss St. Leger as a spotted hyæna. It is the skin of a half-grown representative of the species, which, as explained below, goes through remarkable colour-changes with growth.

"Ikimizi" or "Kibambangwe." In July the Imperial and Foreign News Editor of *The Times* sent to the Museum a note from Capt. Philipps entitled "An alleged unknown beast" passing under these names. It inhabits the lava caves and lava-plain of Bufumbira and Mulera in Ruanda. A sketch of its footprint made in 1919 showed that it is not a leopard. It hunts both by day and night and is said to have short ears and blue-black markings, and to be very ferocious if cornered or come upon at close quarters. The name Kibambangwe is applied in other parts of Bantu-speaking Africa to hyænas and means "the snatcher." It was suggested in 1920 that it might be a black leopard, or possibly a dark giant hyæna. This animal caused great depredations in Bufumbira in 1920; but is reported to be there no longer. Most natives say they have never seen one killed, but believe that no animals will touch the flesh when dead. There is a reference to it in the *Geographical Journal*, 1923, p. 248.

Under the names mentioned above there appear to be no spoils of this animal in the British Museum. Its identification therefore is a matter of conjecture. On the question of the footprint I can give no opinion, unless the sketch above referred to is the same as the one mentioned at the beginning of this article. If so, the track was a hyæna's. On the other hand, the description of the behaviour and appearance of the beast, with its small ears and blue-black markings, forcibly suggests a leopard. Many people, artists in particular, it may be added, can see "blue" in the black pattern of the large Felidæ. Probably two species, the leopard and the spotted hyæna, are con-

fused in the native reports of the doings of the Ikimizi or Kibambangwe.*

"Mushegga" or "Ruturaggo" (plural "Nturaggo," "Ntar-aga"). According to Capt. Philipps this beast killed about 100 people in 1916 in the country of Kinkizi. It will leave goats or sheep and attack those guarding them, especially if they are children. It is found in the fly-forest areas of the Lake Edward plains, whence it comes up the valleys into the highlands of Kinkizi and Ruzhumbura, chiefly by the valleys of the Ishasha and Ntungwe, in which there is ample small game to support it. It is larger than the average leopard and smaller than the local lion, and the animals may be very old and therefore large leopards. The skin at a distance might perhaps be loosely described as having a superficial appearance of a cross between the two (leopard and lion). Hence presumably the theory. It is known as the "Kitálagó," of which the etymology may be Kitalo-engó or wonder-leopard, in reference to its age, size or ferocity. In other parts it is called "Kiisigo," signifying, it is said, that it is larger than the leopard and that it is in fact neither leopard nor hyæna.

These particulars appear to have been jotted down in 1928, but appended to the copy of them reproduced above is a note stating that a skin and skull of the beast obtained in the lower Ntungwe Valley, Edward Nyanza, in July 1929, were posted to the British Museum on September 5.

This skin and skull were examined by Capt. Pitman, who in a letter to Miss St. Leger, dated September 28, says the animal is locally known as the "En-tar-ar-go," adding that the skin appears to be that of an immense spotted hyæna, but the skull has little similarity. The most striking difference is in the dentition, the great fangs (canines) resembling those of a lion, while the molars are narrow and pointed.

In a previous paragraph in the same letter he wrote: "It is possible that a great deal of the mystery which surrounds this animal lies in the fact of its skin being almost identical with that of the spotted hyæna, though the actual creature is half as large again and possesses a different skull, while the dentition is distinctive." Again, when expressing the hope that the skin and skull would be sent to the Museum without delay,

* While this paper was in the hands of the printers Mr. M. A. C. Hinton received from Capt. Philipps a letter in which he says: "Ikimizi, Kimbambangwe, or (by confusion) Mushegga is here [in the central Ntungwe Valley] firmly believed to be a giant hyæna, whereas Kitalaggo or Rutarágo is emphasized as an old or overgrown leopard."

he added, "I really think that Capt. Tracy Philipps may have solved the mystery of one mythical beast to which allusions have been made in the Annual Reports of this Department from the years 1925 to 1928."



FIG. 1.—SKULLS: (UPPER) LEOPARD, (LOWER) "NANDI BEAR."

It does not seem to have occurred either to Capt. Philipps or to Capt. Pitman to doubt the testimony of the collector, presumably a native, that the skin and skull were taken from the same animal. The skin is a spotted hyæna's and may be described as quite normal, in so far as the individual variability in colour and pattern of this species permits the application of that epithet to any one skin of it. Its warm brown colour,

rather indistinct spots, and comparatively pale belly and legs suggest that it was an old animal. But whether it was a large hyæna or not cannot be judged from the stripped and possibly stretched skin. The skull would have told; but it has no skull. The skull associated with it is most emphatically a

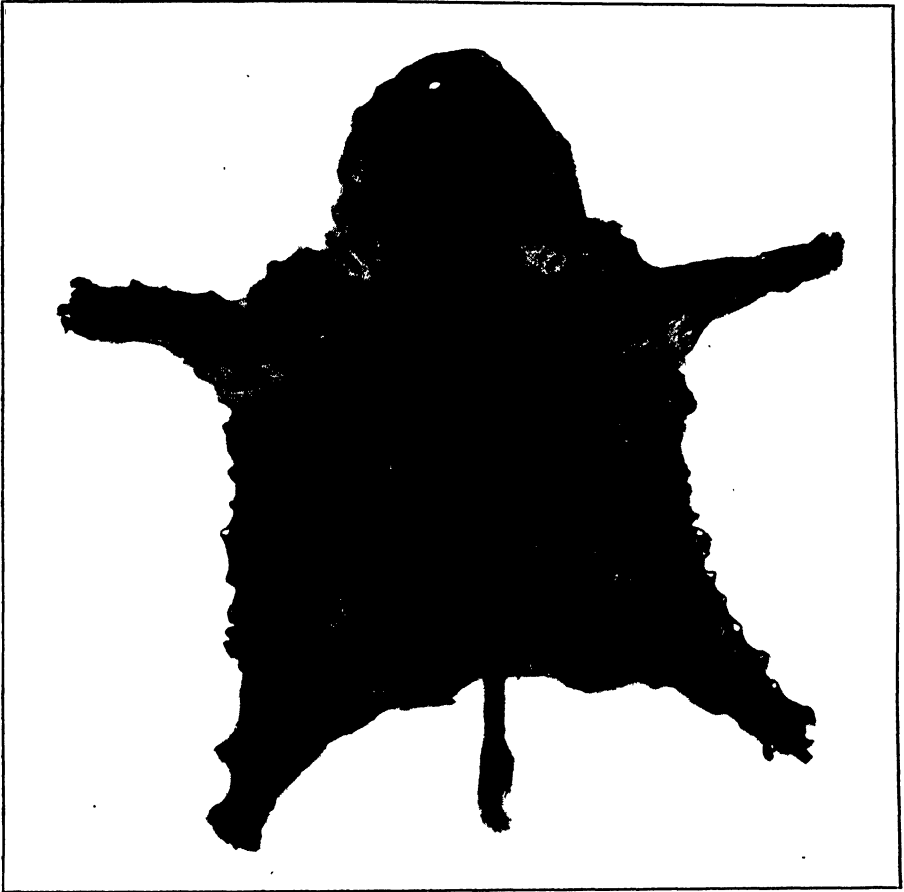


FIG. 2.—SKIN OF "NANDI BEAR" (REALLY A HYÆNA).

male leopard's. It is a big one and, if complete, would probably have exceeded by a few millimetres the longest leopard's skull in the collection of the British Museum; this came from the Welle River in the Upper Congo, whence it was brought by Sir Alfred Sharpe. These two skulls are illustrated side by side in Fig. 1 to show their specific identity; and in Fig. 2 is a photograph of the skin of the hyæna from which the Ntungwe valley leopard's skull was said to have been taken.

Another skull which interested and puzzled Capt. Pitman was obtained by Mr. Temple-Perkins, the District Commissioner of Ankole, who shot this animal a few years ago, but threw away the skin, thinking it was a spotted hyæna's and of no interest. About this skull, which Mr. Temple-Perkins has very kindly presented to the British Museum, Capt. Pitman wrote to Miss St. Leger: "(It) is most certainly not that of a normal hyæna, being more of the jackal or dog type. Yet he (Mr. Temple-Perkins) assures me that all the hyænas in that area (Ankole) have this same type of skull." But Mr. Temple-Perkins must have been mistaken in this matter and thus unwittingly misled Capt. Pitman. The skull is that of a spotted hyæna pup which had just cut its permanent teeth. It is admittedly very unlike the skull of an adult hyæna on account of the complete absence of the muscular crests and constrictions which characterize the cranium of the full-grown beast.

Finally, a "Ruturaggo" skin, obtained at 6000 feet in the Ntungwe valley, was sent to the Museum by Capt. Philipps in October. It is the skin of a young spotted hyæna, tawny cream in colour with conspicuous black spots on the body and blackish on the belly and legs. It was in connexion with this skin that the admonitory explanation of the appearance of six toes, due to the bisection of the plantar pad, was sent.

From the evidence set forth in this paper, founded upon the specimens and notes kindly sent to the Museum, it will be admitted, I think, on all hands that Capt. Philipps and Capt. Pitman have successfully and finally cleared up the mystery that hitherto enshrouded the "Nandi Bear" with its numerous native aliases; and everyone will agree with Capt. Pitman that "the Chemosit, Kateit, and Gereit of the Mau Escarpment and Nandi country; the Sabrookoo of the Bagishu and Sabai of Mt. Elgon; the Engargiya of Buganda and parts of Bunyoro; the Entarargo of Kigezi and Ankole and particularly of the escarpment and forests east of Lake Edward; the Kabi-riro of Toro and the Ondularwo of southern Lado, evidently refer to the same creature."

The entire story of this fabulous monster attests the unreliability of information derived from native sources. For setting aside the single skull of the leopard, all the material of it sent in has proved it to be the spotted hyæna. It is greatly to the credit of Capt. Philipps and Capt. Pitman that although aware that in many instances their mysterious beast had turned out to be that familiar animal, they still persevered in their attempts to find out by inquiries in all directions if there

was possibly another as yet undescribed large predatory carnivore forming at least part of the foundation of the stories.

Although the confusion that has arisen is clearly due mainly to the fancies and fears of natives, I suspect that want of acquaintance with the remarkable colour-changes of the spotted hyæna during growth and with its individual variability after reaching maturity has contributed to that end. The newly-born cub is uniformly coloured black or brown and the coat is short and sleek. The half-grown animal has a shaggy coat and the pale tone of the adult begins to appear on the head and neck and as irregular blotches on the body, the legs and underside retaining the dark hue of puppyhood. Sometimes these areas are quite dark in tolerably large individuals in which the extension of the bleaching has so far affected the body and flanks that the blackish-brown tint of the young is represented merely by the spots. Finally, in some adult or old individuals, though possibly not in all, the belly and legs become the same brownish or tawny tint as the body or even paler. It was formerly thought by many zoologists that differences in colour and cranial character in mature spotted hyænas were trustworthy indices for the differentiation of species; and many specific and subspecific names have been given to specimens from East Africa and elsewhere on this erroneous assumption. It is now known that in both the particulars named adult hyænas from the same locality differ considerably from each other.

RECENT IMPORTANT ALTERATIONS AND ACQUISITIONS.

A NEW case has been placed on exhibition in the Central Hall to illustrate the Locust plague and the agencies, natural and artificial, by which it is to some extent controlled. Examples of various kinds of swarming locusts are exhibited, and drawings and specimens to show the life-history of a typical species. Photographs of the devastation caused by the scourge and of operations for combating it are included, and also specimens or representations of some of the numerous birds, insects, and other natural enemies of the pest. One of these, a Hunting Wasp (*Sphex ægyptius*) is seen in the act of dragging to its burrow, as food for its future grub, a locust which it has paralyzed with its sting.

* * * * *

Department of Zoology.

Several specimens of the Nkosi Island Situtunga (*Limnotragus spekei sylvestris*), recently described by Colonel R. Meinertzhagen, together with a large

number of other species; presented by Captain C. R. S. Pitman, Game Warden of Uganda. Captain Pitman was permitted to shoot these antelopes specially for the Museum through the good offices of the Government of Uganda. Nkosi Island, the southernmost of the Sesse Group, in the Victoria Nyanza, is an island covered with dense, dry forest, and the situtungas, which are usually swamp-dwelling antelopes, have assumed more terrestrial habits. Colonel Meinertzhagen estimated that in 1926 there must have been at least 200 of these animals existing on Nkosi Island.

A fine pair of horns of the Black Rhinoceros (*Rhinoceros (Diceros) bicornis bicornis*); bequeathed by the late Mr. Henry Allin Martyn. The specimen was shot in Kenya Colony by the testator, and is of exceptional interest in that the rear horn is longer than the front horn. This rhinoceros represents the Keitloa type which formed the basis for the description of a species known as *Rhinoceros keitloa* which has since been shown to have been founded on nothing more than an individual variation.

A fine example of the Common Porcupine (*Hystrix cristata*); presented by the Trustees of the Rowland Ward Bequest. The specimen is of additional interest in that it is mounted in a defensive attitude with its spines erected. This is the first example of the Common Porcupine that the Museum has received mounted in this manner.

A collection of nearly 600 slides of microscopic preparations of water-mites, forming the material described in the standard monograph, "British Hydracarina," by Mr. Soar and Mr. Williamson, published by the Ray Society (1925-29, 3 vols.); presented by Mr. C. D. Soar. The water-mites, although little known except to amateur microscopists who are interested in pond life, form a group of animals remarkable for brilliancy of colour and eccentricities of form. Many of the preparations in Mr. Soar's collection are remarkable examples of the mounter's art, and the collection as a whole is of exceptional value as providing a standard of comparison for future workers in the group.

Department of Entomology.

The whole of the donor's collection of butterflies from South and Central America belonging to the subfamily Theclinae, amounting to between five and six thousand specimens and including eighty-eight types; presented by Mr. J. J. Joicey. Many of the types represent species of very considerable rarity. The butterflies of this subfamily, of which the few British representatives are known as Hairstreaks, are mostly small in size, but are noted for the extraordinary brilliance of their colouring. The present donation, which will very greatly enrich the existing Museum collection, recalls a similar generous gift made by the same benefactor in 1925, consisting of some 40,000 specimens representing the whole of his Hesperiidæ.

A collection of Cynipidæ (gall-flies), containing examples of more than sixty species, including some seventy paratypes; presented by Mr. L. H. Weld.

The collection of Psychodidæ (moth-flies) formed by the late Rev. A. E. Eaton, and including over 1800 pinned specimens and about 200 microscope slides; presented by Mrs. M. E. Eaton. The tiny insects known as moth-flies are familiar to most people from the habit of some species of running on window-panes; but, owing perhaps to their small size and the difficulties of manipulation, they have seldom been collected and studied. It is probable that the Eaton collection is the largest and most important in existence, including as it does, in addition to a complete series of the known British species, much material from Switzerland, Algeria, Madeira, the Canary Islands, and elsewhere. For thirty years before his death on the 23rd March, the

late Mr. Eaton had made the collecting of these little flies his special hobby, paying particular attention to species connected with running water. He had also accumulated extensive notes in preparation for a monograph on the group, and it is hoped that it may be possible to publish some parts of his manuscript.

2500 specimens of British saw-flies, collected by the donor; presented by Mr. Robert B. Benson. This donation includes specimens which will be made the types of species new to science as well as to the collection, and fine series of many rare species in excellent condition.

Six examples of *Pantophthalmus tabaninus*, Thunb., a large two-winged fly, specimens of which sometimes measure as much as two inches in length; presented by Mr. F. W. Urich, Port of Spain, Trinidad. The species of the genus *Pantophthalmus*, which occurs in the West Indies and other parts of Tropical America, are the largest of all Diptera; notwithstanding their formidable appearance, however, these flies are quite harmless and are incapable of biting. Their larvæ have the remarkable habit, unique among Diptera, of boring in the solid wood of living trees, in which they gouge out clean-cut, nearly horizontal tunnels, and feed upon the exuding sap.

A green cicada (*Cystosoma saundersi*, Westw.), taken by the donor at Eungella, Queensland; presented by Mr. Frank H. Taylor. The song of this insect, which in New South Wales and Queensland occurs locally in vast numbers, is heard in hot and sultry weather before a thunder-storm. It is said to be unlike the shriller and harsher notes uttered by the common cicada, and to resemble the sound of a loud, deep and guttural "R," continued incessantly, with vibrations.

Department of Geology.

The Buckman collection of fossil brachiopoda and ammonites; purchased. This numbers about 25,000 specimens, mostly brachiopods, and nearly all from the English Jurassic rocks. It is the bulk of the material collected by the late Prof. James Buckman and his son, the late Sidney Savory Buckman. The former had unique opportunities for collecting, since he lived in the south-west of England when the early railways were being made, and this involved not only the opening of the railway-cuttings, but also the quarrying of local stone for bridges, etc. His son studied and collected from the English Jurassic strata all his life. He acquired a specialist's knowledge of brachiopods and ammonites, and gained a world-wide reputation. His fertile brain did not stop at mere classification, but was continuously following philosophical by-paths, and startling the scientific world with theoretical considerations both in palæontology and stratigraphy. His collection is therefore of interest, not only for its intrinsic value, but still more for enabling future workers to understand and test Mr. Buckman's work.

A large portion of the skeleton of a rhinoceros, *Diceratherium cooki*, from the locality in Nebraska which yielded the skeleton of *Moropus*; purchased. The present specimen represents a fully adult animal, rather larger than a Shetland pony. The diceratheres are distinguished from all other rhinoceroses by having the paired nasal horns placed side by side instead of tandem. They arose in North America (where the stages of their evolution have been clearly made out) and migrated to Europe: bones and teeth have been found in France.

Microscope-preparations of Carboniferous and Cretaceous plants; British Carboniferous sponges; Ordovician polyzoa from Canada; paratype specimens of Indian Jurassic brachiopoda; British Eocene brachiopoda; Miocene echinoids and lamellibranchs from Jamaica; holotype specimens of British

Jurassic cephalopoda; mammalian remains from the Lower Pliocene of the Punjab; skull and horn-cores of *Bos primigenius* from a Pleistocene turbary deposited in the Test valley; an extensive series of fossil plants from the Wankie coal-field in Rhodesia; an opalized shell from the Cretaceous of New South Wales; cephalopoda from the Jurassic and Cretaceous of north-west Persia; fossil fishes from the English Chalk; two mammoth jaws from Farnborough, Kent; and a cast and enlarged model of the tooth of the fossil man *Sinanthropus pekinensis* from the Pleistocene of China; purchased.

Department of Mineralogy.

A collecting trip made by the Keeper of Minerals in connexion with the meeting of the International Geological Congress in South Africa last August resulted in the acquisition of a large number of interesting specimens from the various mining districts, many of them being generously presented by the mine officials, including:—a large block (96½ lb.) of strongly magnetic lodestone from the Bushveld north of Pretoria; a small but complete meteoric iron found on the desert near Gibeon, South-West Africa; a large series of crystallized zinc phosphates and pyromorphite from the new working in Kopje No. 2, and fine crystals of zinc carbonate from Kopje No. 5, at Broken Hill in Northern Rhodesia; large masses of willemite from the Star Zinc mine near Lusaka in Northern Rhodesia; and many others, in all 37 lots of material, which will be useful for study and exchange purposes.

Many specimens of minerals and rocks recently collected in Northern Rhodesia and South-West Africa have been added to the Mineral Collection. The Rhodesia Broken Hill Development Company have given a beautiful specimen, suggestive of a Japanese ornament, which well illustrates the growth of crystals. Limpid crystals of hopeite (zinc phosphate) are clustered in cavities of a fractured mass of iron ore which shows up in patches with a brilliant red colour, and over these minerals is a later growth of small green crystals of pyromorphite (lead chloro-phosphate). Other specimens from the new open workings in Kopje No. 2 at Broken Hill are large crystallized masses of green pyromorphite and white hemimorphite (zinc silicate), which were collected and presented by Mr. F. N. Ashcroft. The Secretary for Mines of Northern Rhodesia has given a fine crystal of garnet and other minerals from the mica mines in the Batoka district. The South-West Africa Company has given a fine group of large crystals of thenardite from a salt-pan in Amboland, and a series of crystallized vanadium and zinc minerals from the Grootfontein district. Other specimens collected by the Keeper of Minerals during his recent visit to South-West Africa are curious wind-worn stones from the Namib desert and large masses of a remarkable form of zinc-blende from Tsumeb, which when scratched, or even when scrubbed with a brush under water, emits a brilliant luminescence.

Two small diamond crystals with inclusions of quartz from Rio das Garças, Goyaz, Brazil; presented by Dr. Djalma Guimarães.

A fine specimen of massive blue sodalite in nepheline-syenite from the neighbourhood of Bangalore, Mysore State; presented by the Director of the Geological Survey of India.

Magnesite from the Zhob Valley, Baluchistan; presented by Captain W. G. Lang-Anderson, R.E.

Fine crystals of hæmatite from Mt. Popa, Burma; presented by Mr. A. C. D. Pain.

A series of lithium-bearing minerals from Manitoba; presented by the Silver Leaf Mining Syndicate.

Gold from Edie Greek, New Guinea; presented by Mr. H. Darby.

A large block (86½ lb.) of tinstone from Mergui, Lower Burma; presented by Mr. E. Ahmed, M.B.E.

Rocks from Northern Rhodesia, Uganda, Kenya Colony, Abyssinia, Arabia, etc.

A 10½-lb. mass of bright blue lazulite (a mineral closely resembling lapis-lazuli, but belonging to the phosphate division) from South-West Africa; a large crystal of diopside from Madagascar; a faceted specimen of hambergite, weighing 3.6 carats, from Madagascar; and various Italian minerals; purchased.

Department of Botany.

The herbarium of British Pondweeds collected by the late Mr. Arthur Bennett, A.L.S.; purchased. Mr. Bennett had made a lifelong study of the genus *Potamogeton*, and was a recognized authority upon it. The value of his herbarium is much enhanced by the inclusion of numerous notes and correspondence relating to the specimens.

The Keeper and the Deputy Keeper of Botany, who visited South Africa during July and August, collected for the Museum, respectively, about 600 specimens of plants, from Teneriffe, St. Helena, the Cape Province, Southern Rhodesia, Zanzibar, and Kenya Colony; and numerous specimens of the smaller fungi, especially those acting as diseases on the stem and leaves of flowering plants.

BOOK NOTICES.

A Handbook of the Dragon-flies of North America. By JAMES G. NEEDHAM and HORTENSE BUTLER HEYWOOD, assisted by specialists in certain groups. Pp. viii + 378, with numerous text-figures. 1929. (Springfield and Baltimore: Charles C. Thomas. London: Baillière, Tindall and Cox. 31s. 6d.)

THIS book is primarily intended for collectors of dragon-flies and does not claim to be an exhaustive treatise dealing with the morphology of the Odonata. Its object is to enable collectors to identify their captures and to give them the best knowledge of their life-history, habits and distribution. Diagnostic keys to the genera and species are given, and the accessory genitalia and appendages of the majority of the species are figured.

The book is divided into two sections: General and Systematic. The first deals with the structure of the dragon-fly and of its immature stages, its habits, and the methods of collecting, rearing and preserving the insects. The second and greater part of the book contains systematically arranged descriptions of the species of North American dragon-flies. These descriptions have been kept as concise as possible, and references to the more important papers since Muttkowski's "Catalogue of the Odonata of North America" (1910) are given after the specific name. Then follow details of the earlier stages and an account of the habits and the habitat in which the species may be found. A list of over 160 works cited in the book is given, and there is an index to the text and figures.

Miss Elsie Broughton is responsible for the sections dealing with the genera *Aeschna* and *Somatochlora*, and Mr. C. Francis Byers for those on *Argia*, *Enallagma* and *Ischnura*.

A few errors have been noticed. For instance, on p. 12, in treating of the thorax of the adult, reference is made to Fig. 27, which represents a nymph, and on p. 10 a short paragraph is repeated almost word for word. The figures of the appendages appear to be good, although in one or two instances it is doubtful to which species certain figures are to be referred. In many instances the

illustrations would have been more useful to the collector if the individual drawings had been numbered and explanatory matter added. The type used in naming some of the figures might have been larger and clearer.

Apart from such slight details, the authors have succeeded in producing a book which will not only enable collectors to identify their captures, but will also provide them with all the available information concerning the habits and life-histories of the North American dragon-flies, and thus direct the attention of future workers to those species whose life-cycles have not yet been elucidated.

Aids to Zoology. By HARRY LISTER, M.Sc., F.Z.S. Pp. viii + 24, with 29 figures. 1929. (London: Ballière, Tindall and Cox. 3s. 6d.)

THIS little book "has been written primarily for the student revising for a first-year examination in Zoology." A few quotations may serve to indicate its quality:—"Thus, the Vertebrata is divided up in orders—e.g. Insectivora (insect-eating types); Ungulata (eaters of vegetable material); Carnivora (flesh-eaters); Primates (monkeys, apes and man)." "There are various kinds of cats belonging to the same genus *Felix*." "Some Foraminifera have "arranaceous shells." "The evolutionist says that man, ape and primate have arisen from a common stock in past ages."

An Introduction to the Study of Bird Behaviour. By H. ELIOT HOWARD. Pp. xii + 136, with 10 plates, frontispiece, and 2 plans. 1929. (Cambridge University Press. 42s.)

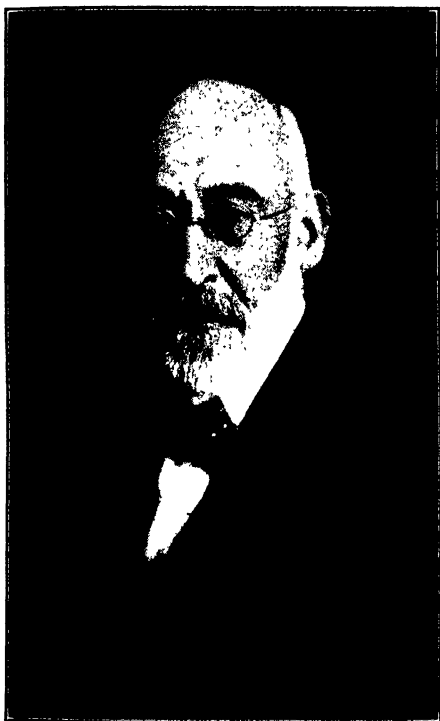
MR. ELIOT HOWARD is already famous for his two books, "The British Warblers" (1907-14), and "Territory in Bird-Life" (1920), both remarkable for the expression of original ideas. His new book is likely to remain a classic because for the first time an attempt has been made to explain on purely physiological grounds the behaviour of a bird from the very beginning to the end of the reproductive period. To obtain the necessary information entailed an almost incredible patience and persistence of purpose. Two species of birds, the Reed Bunting and Yellow Bunting, were watched continuously. This meant rising and being abroad before daybreak in the dark and chilly mornings of early February when the first departure from the winter routine might be expected to manifest itself. These observations were kept up almost continuously till well into May, when the young were hatched and being fed by the parents. It will be the duty of every student of the physiology and psychology of animal behaviour to read this book, which constitutes a serious and very valuable contribution to the subject. Mr. Howard must be congratulated on having produced a most interesting and instructive work. The book is beautifully printed and sumptuously illustrated with lifelike pictures by Mr. G. E. Lodge.

STAFF NEWS.

DR. A. B. RENDLE, M.A. (Cantab.), D.Sc. (Lond.), F.R.S., Keeper of the Department of Botany, retires from the service of the Trustees on January 19, 1930, on reaching the age limit.

Alfred Barton Rendle was born in London on January 19, 1865, and was educated at St. Olave's Grammar School, Southwark, and at St. John's College, Cambridge, where he held a scholarship. He graduated in the Natural Sciences Tripos, with second-class honours in Part I in 1885 and with first-class honours, with distinction in Botany, in Part II in 1887. He obtained the Doctorate of Science at London University in 1899.

Dr. Rendle joined the staff of the British Museum as Second-Class Assistant (old style, now Assistant Keeper) in the Department of Botany on October 25, 1888, and was appointed Keeper of the Department in succession to Mr. George Murray on January 11, 1906. He contributed to various Museum publications, including "Catalogue of Welwitsch's Angolan Plants—Monocotyledons" and "Talbot's Nigerian Plants," and was joint author of "Flora of Jamaica." He has published numerous papers descriptive of collections received at the



[Photograph by F. A. Swaine, Ltd.]

ALFRED BARTON RENDLE, M.A., D.Sc., F.R.S., WHO SHORTLY RETIRES FROM THE KEEPERSHIP OF THE DEPARTMENT OF BOTANY.



[Photograph by Wykeham Studios, Ltd.]

BASIL HARRINGTON SOULSBY, M.A., WHO SHORTLY RETIRES FROM THE ASSISTANT KEEPERSHIP IN CHARGE OF THE LIBRARY.

Museum or on special groups of flowering plants in the *Journal and Transactions of the Linnean Society*, *Journal of Botany*, and elsewhere, and is the author of the text-book, "Classification of Flowering Plants," published by the Cambridge University Press. He has been Editor of the *Journal of Botany* since 1925, and is Honorary Professor of Botany to the Royal Horticultural Society.

His services to botanical science were recognized by his election to a fellowship of the Royal Society in 1909. From 1916 to 1923 he was Botanical Secretary of the Linnean Society and President from 1923 to 1927. He was President of Section K (Botany) of the British Association for the Advancement of Science in 1916, of the Quekett Microscopical Club from 1917 to 1922, and of the South-Eastern Union of Scientific Societies in 1927. He is Honorary Member of the Botanic Society of Edinburgh, Foreign Honorary Member of

the American Academy of Arts and Sciences, Honorary Member of the Boston Society of Natural History, and Honorary Associate Member of the Société Royal de Botanique de Belgique, and holds a Victorian Medal of Honour of the Royal Horticultural Society.

* * * * *

Mr. Basil H. Soulsby, M.A., Assistant Keeper in charge of the Library, retires from the service of the Trustees on January 20 after nearly thirty-eight years of service.

Basil Harrington Soulsby, who was born in New Zealand on November 3, 1864, was educated at Cheltenham College from 1877 to 1883, and at Corpus Christi College, Oxford, from 1883 to 1887; he graduated B.A. in the school of Modern History in 1887. He was a student at the University of Göttingen during 1888. He entered the service of the Trustees of the British Museum as Second-Class Assistant (old style, now Assistant Keeper) in the Department of Printed Books on June 21, 1892. He was subsequently Superintendent of the Copyright Office, and of the Map Room, and Deputy Superintendent of the Reading Room, from 1894 to 1909, when he was transferred to the Natural History Museum as Assistant in the Director's Office. On January 1, 1921, he was appointed Librarian in succession to Mr. B. B. Woodward. From 1892 to 1914, and from 1921 onwards, he has each year visited foreign Museums and Libraries. He edited the second edition of the "Catalogue of the Works of Linnaeus in the British Museum," 1929. The Linnean collection in the Natural History Museum is, next to that in the University of Upsala, the most extensive in the world.

* * * * *

The Trustees have appointed Mr. J. Ramsbottom, O.B.E., Keeper of the Department of Botany in succession to Dr. A. B. Rendle, F.R.S. Mr. Ramsbottom was promoted to a Deputy Keepership on February 18, 1928, and an account of his career appeared in the number of this Magazine for January 1928 (Vol. I, p. 176). Since that date he has been elected President of the Quekett Microscopical Club.

Mr. Gilbert J. Arrow, Assistant Keeper, Department of Entomology, was promoted to the Deputy Keepership vacated by Mr. Ramsbottom. Mr. Arrow was educated at Clapham High School, and for a short time at King's College and the Birkbeck Institute (now Birkbeck College), London. He was appointed a Second-Class Assistant (old style, now Assistant Keeper) in the Department of Zoology, from which the Entomological section had not then been divided, on May 21, 1896, and has been in charge of an important part of the collection of Coleoptera (Beetles) during the whole of his service.

* * * * *

MR. B. H. SOULSBY, Assistant Keeper in charge of the Library, represented the Museum at the Annual Conference of the Association of Special Libraries and Information Bureaux at Cambridge in August.

* * * * *

DR. G. F. HERBERT SMITH, Assistant Secretary, represented the Museum at the Centenary Celebrations of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne, at the Hancock Museum, Newcastle-upon-Tyne, on October 17.

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Vol. II

THE EMPEROR'S PIKE : A FISH STORY

By J. R. NORMAN, Assistant Keeper, Department of Zoology.

HANGING in the study of the Keeper of Zoology is an old oil painting of a large Pike, which bears a curious inscription in English on the face of the canvas. This painting, which is somewhat in need of restoration, has been photographed and is reproduced herewith (Fig. 1).^{*} I have been unable to discover its history, beyond the fact that it was presented to the British Museum by Robert Few, Esq. The inscription, which is clearly legible on the photograph, runs as follows :—

“ THIS IS THE BIGGNESS OF THE PIKE, WHICH
THE EMPEROR FREDERICK THE SECOND
WITH HIS OWN HAND, HATH PUT
THE FIRST TIME INTO A POOLE AT
LAUTERN ; AND HATH MARKED HIM
WITH THIS RING IN THE YEARE
1230.
AFTERWARDS HEE BROUGHT HIM TO
HEYDELBERG THE 6 OF NOVEMBER
1497.
WHEN HEE HAD BEENE IN THE
POOLE 267 YEARES.”

This story of the Emperor's Pike, as it is generally called, has been a great favourite with all writers on fishes since the sixteenth century, and it appears with various emendations and embellishments in most of the standard works on fresh-water fishes. The original account, with a wood-cut illustration of the ring, is to be found in a well-known work published by Gesner in 1558.[†]

^{*} I am much indebted to the authorities of the Victoria and Albert Museum for permission to photograph the painting in their studio, and especially to Mr. Mutimer, the Museum photographer, for the benefit of his advice and experience.

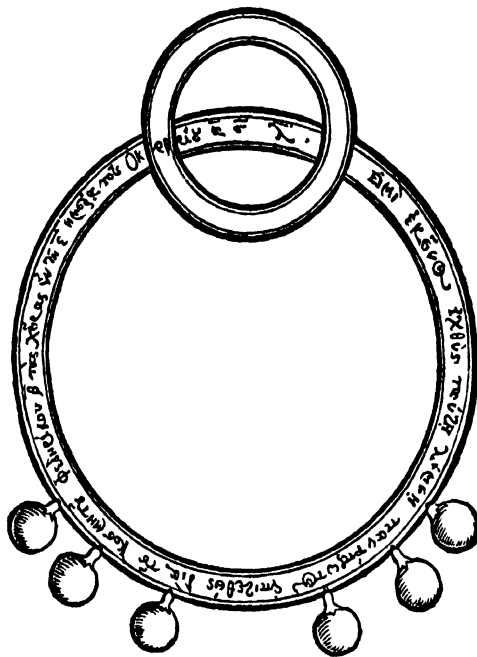
[†] Conradi Gesneri medici Tigurini Historiæ Animalium Liber IIII. qui est de Piscium & Aquatilium animantium natura. . . . Continentur in hoc volumine G. Rondeletii . . . & P. Bellonii . . . de Aquatilium singulis scripta. folio, Tiguri, 1558. (Epistola Nuncupatoria, [p. 5].)



FIG. 1.—THE EMPEROR'S PIKE.
From a painting in the British Museum (Natural History).

Nuncupatoria.

charus et familiaris fuit: ut Plinius, qui et ipse de omni animalium genere copiose scripsit, Vespasiano: adeò quidem ut in Naturalis Historiæ suæ dedicatione non maioribus titulis quàm Vespasianum suum, et iucundissimum Imperatorem appellet. Plutarchum, cuius libros De animalium ingenio aut ratione (ut dixi) habemus, Traianus amavit. Fridericus II. Imperator, cum aliàs uir eruditus fuit, & Græcè etiam (mirum illo seculo) calluit: tum animalium naturæ studiosus fuisse uidetur, ex eo quòd (ut tradit Conradus Celtis) Lucius piscis anno Salutis M. CCC. XCVI. captus est in stagno circa Haylprun imperialem Sueviæ urbem: & repertus in eo annulus ex ære Cyprio in brachijs sub cute, modica parte splendens uisus. Annuli figura & inscriptio fuit hæc.



Verba Græca circumferentiæ inscripta: Εἰμι ἰκεῖνος ἰχθύς πάντῃ λιμνῇ παντοκράτορος ἡγευθεὶς διὰ τοῦ κοσμοκτοῦ ἐνδυναμῶν δ' αὖτ' ἡγεῖται τοῦ οὐρανοῦ β. Latinè sonât, (licuti Ioannes Dalsburgus Vuormaciensis episcopus interpretatus est:) Ego sum ille piscis huic stagno omniū primus impositus per mūdi Rectoris Federici secūdi manus, die quinto Octobris. Numeri Græci in epicyclo annū Salutis indicant, quo id factū est, M. CC. XXX. Sex minores circuli, significare Imperij electores putantur. Inde colligitur piscem illum in stagno uixisse annis CC. LXVI. Hoc quidē factō Federicus II. Alexandrum Magnum imitatus uideri potest: Ceruos enim captos aiunt, teste Plinio, post centum annos cum torquibus aureis, quos Alexander Magnus addiderat, ad opertis iam cute in

FIG. 2.—GESNER'S DESCRIPTION OF THE EMPEROR'S PIKE.

A photograph of a part of the page in Gesner's work is reproduced here (Fig. 2). A rather free translation of his description runs as follows :—

“ In the year of grace 1497 a pike was caught in the lake near Haylprun * an imperial city of Swabia † : and in it was found a copper ring which was rather bright, in the gills beneath the skin. The figure and the inscription on the ring are shown here. The Greek words inscribed on the circumference are . . . [see figure]. According to the translation of Johannes Dalburgus, the bishop of Worms, this reads in Latin : ‘ I am that fish which was first of all put into this lake by the hands of the Emperor of the World Frederick the Second, on the fifth of October.’ The Greek numerals on the ring indicate that the year of grace in which this was done was 1230. The six smaller rings are believed to signify the Imperial Electors. From this one may assume that the fish lived in the lake for 267 years.”

After Gesner the story crops up again in various works in several languages, but if these are carefully compared, as has been done by Valenciennes,‡ some marked discrepancies are found to exist. For example, the authors are unable to agree as to which of the Fredericks was responsible for placing the fish in the Lake, Frederick the Second or his father, or as to the locality at which it was finally recaptured.

Gesner states that the fish was caught at Heilbronn in Swabia. Lehmann (1592) § gives the same locality, and states that a life-size picture of the pike and a figure of the ring were to be seen in a tower on the road between Heilbronn and Spires. Crusius || (1594–96), although he found in various manuscripts that the fish was caught near Kaiserlautern, inclined to the view that the capture really took place at Heilbronn, chiefly because the painting was at the latter place. He adds that possibly Frederick the Second may have placed several pike in different lakes at the same time, and that another of these may have been caught in the same year. Freher (Marquard), a contemporary of Crusius ¶ (1613), was certain that Kaiserlautern was the place of capture, and tells us that Frederick the Second was in the habit of resting here in the intervals of his campaigns. He further informs us that as late as the year 1612 the water from

* Heilbronn.

† Neckar Kreiss, Württemberg.

‡ “ *Histoire Naturelle des Poissons*,” XVIII, 1846, pp. 305–12.

§ “ *Chronica der freien Reichsstadt Speier* ” (Valenciennes).

|| “ *Ann. Suevici*,” II, pp. 25–26 (Valenciennes).

¶ “ *Origines palatinae*,” II, p. 54, Heidelberg (Valenciennes).

which the fish was taken was still called "Kaiserwag" or the "Emperor's Lake," and that a picture of the pike could be seen at the castle of Lautern, with the length of the fish indicated by a black line nineteen feet long. He adds that the copper ring with the smaller ones attached, taken from the gills of the pike, had been preserved, and that the painting bore the following inscription in German :—

"Diss ist die Grösse des Hechts so Kaiser Friderich dieses Namens der ander, mit seiner hand zum ersten in den Wag zu Lautern gesetzt, und mit solchem Ring bezeichnet hat anno 1230; wurd gen Heidelberg gebracht den 6ten Novembris 1497, als er darin gewesen war 267 Jahr."

It will be observed that the legend on the painting in the Museum is nearly an exact translation of the above, and it is probable that the painting itself is a copy of that in the castle of Lautern. Mr. Martin Hardie, of the Victoria and Albert Museum, has been kind enough to examine the painting, which he regards as seventeenth-century work—possibly from the first half of the century.

Later authors have done little more than reproduce the story as outlined above in one form or another, but one or two writers of comparatively recent years have added further details, without, however, revealing the source of their information. For example, Day (1880–84) * tells us that the fish when captured was "17 or 19 feet long and weighed 550 lbs."

The whole matter was discussed at some length by Valenciennes in 1846,† from whose account some of the information contained in this article has been drawn. He agrees that a pike of some size was probably caught in the neighbourhood on the date in question, and adds that it was the custom in earlier times to put metal rings into the gill-covers of fish. The reputed great age of the fish he regards as an exaggeration, "*que l'amour du merveilleux a fait grossir les objets, afin de leur donner plus d'importance et d'accroître leur renommée.*" Finally, he points out that the skeleton of this famous fish is reputed to have been long preserved in the cathedral at Mannheim, and that this measured 19 feet; but that this had been examined by a celebrated German anatomist (not named), who found that the vertebræ in the backbone were too numerous to belong to a single individual . . . in other words, that the skeleton had been lengthened to fit the story !

* "Fish : Great Britain and Ireland," II, p. 144.

† *l.c.* p. 305.

A REMARKABLE INMATE OF A BEE'S NEST.

By GILBERT J. ARROW, Deputy Keeper, Department of Entomology.

OF the many curious ways of life adopted by insects, some of the strangest are exhibited by those which have attached themselves as uninvited guests to the communities of the various Social Insects, or been introduced as domestic animals by the latter. So prosperous are those communities and so desirable the protection from weather and enemies, as well as the abundance, to be found under their roof, that the number of such

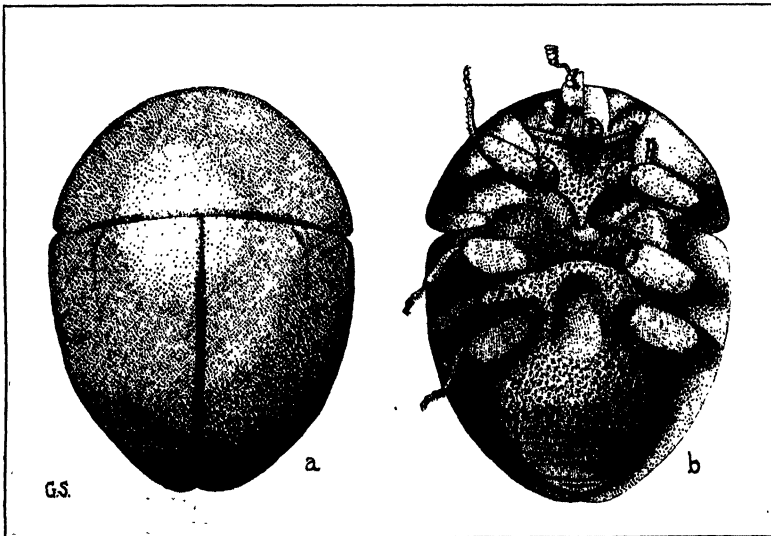


FIG. 1.—BEETLE (*Cleidostethus meliponae*).

a upper and *b* lower surface.

Half the head is represented drawn out of its cavity. (Much enlarged.)

inmates, living amongst them, sometimes with, and sometimes without, the goodwill of their hosts, is very great. The nests of Ants, Bees and Termites (or White Ants), all have such alien inhabitants in great variety, and many of them exhibit the most remarkable forms and characteristics, for so peculiar a manner of life involves very special adaptations. Some of them secure the goodwill of their hosts by performing some service valued by them, some produce a sweet liquid particularly agreeable to their protectors and are fed luxuriously in return and even allowed to prey at will upon the brood of the nest. One of these pampered assassins is the strange caterpillar of the Large Blue Butterfly, which, in spite of its murderous propensities, is treated

with the utmost solicitude by ants, which carry it into their nest and shelter it during the winter, the butterfly emerging there the following summer.

Other inmates feed upon the substance of the nest, its contained stores, eggs or young, without securing the goodwill of the owners, maintaining themselves by virtue of special means of defence against their attack.

The tiny beetle (Fig. 1) represented here (to which has been given the name *Cleidostethus meliponae*) has been recently discovered in Africa in the nest of a Social Bee (Fig. 2). The latter, *Melipona alinleri*, is one of the Stingless Bees, which form large colonies within hollow trees. The beetle appears a peculiarly helpless little creature, without defensive weapons and without secretory organs such as many ant-guests possess. Moreover, it is completely blind, incapable of flight and evidently possessed of only very moderate powers of locomotion. The bees upon which it has quartered itself and at whose expense it lives, although without sting, can bite



FIG. 2.—INTERIOR OF A MELIPONINE BEE'S NEST IN A HOLLOW TREE, SHOWING BROOD-COMBS IN THE MIDDLE AND HONEY-POTS ABOVE AND BELOW. (Much reduced.)

viciously, and it might have been supposed that they could evict the unprotected little beetle without difficulty. Its entire organization, however, seems to be designed to prevent this. The absence of eyes renders the head so small that it can be withdrawn into a kind of pocket, where it is completely concealed. The legs fold up and fit into cavities beneath the expanded margins of the body, and so, when the little creature (it is barely one-sixteenth of an

inch long) "sits tight," with its outer edges pressed close to the surface on which it rests, all its vulnerable parts are enclosed like those of a limpet upon a rock. In addition, the two wing-cases, having no wings to uncover, are firmly fixed together; and there is a whole series of interlocking devices to hold the front and hinder parts of the body rigidly attached, as though to resist any attempt to pull the insect from its base.

How this blind beetle lives in the bee-nest is entirely a matter of conjecture. The young of the bees live each in a separate closed cell, in which the egg, together with a mass of honey and pollen for food, is sealed up by the worker-bees. The beetle possesses no organs capable of penetrating the waxen cells, so, although its affinity is with the Coccinellidae, or Ladybirds, a predacious tribe, we may dismiss the idea that it preys upon the eggs or young of the bees. It seems more probable that it feeds upon the general food-store of the colony, which is collected in large receptacles that remain open for a considerable time.

A still more perplexing problem is—how does the beetle make its way from one *Melipona* nest to another? From its degenerate, blind and wingless condition it is evident that it has led this parasitic life for countless generations and is totally incapable of an independent existence. The *Melipona* nest exists only for a few years, the hollow tree containing it eventually decays and falls, and the bees swarm and found other colonies at a distance. By some means the parasite must make its way into these, but such an achievement seems impossible for a beetle which can neither see nor fly. Is the migration accomplished in the egg or larval stage? It is quite likely that the still-undiscovered grub is a less degenerate creature than its parent, but it is still inconceivable how so minute an insect can make its way through the world to the, perhaps remote, tree in which a new home is to be found, unless, like certain other beetle-larvae which live in the cells of Solitary Bees, it is able at the right moment to cling to the hair of the bee itself and so enter with the swarm into their new quarters.

In the accompanying figures, the legs are shown folded up on the one side and unfolded on the other, and one half of the head is represented as having been drawn out of its cavity to show its form, while the other half is just visible in its natural position. These drawings, as well as the photograph of the interior of the nest of an American bee of a species related to *Melipona alinderi*, are the work of Dr. George Salt, by whom the beetle has been presented to the Museum.

REPORT ON THE BRITISH MUSEUM EAST AFRICA EXPEDITION. SEASON 1929.

By F. W. H. MIGEOD, Leader of the British Museum East Africa Expedition.

THE British Museum resumed work in East Africa last April after the temporary closing down of its expedition at the end of the previous year. This step was rendered necessary by the exhaustion of available funds. A grant, however, made by the Government of Tanganyika Territory enabled the search for dinosaur remains to be continued. The stores of the expedition had been left at Tendaguru in charge of two reliable workmen; and the buildings required no more than re-thatching.

Tendaguru, about fifty miles north-west from the port of Lindi, is proved ground, and, as it was considered extremely probable that this area still contained extensive dinosaur remains, several square miles were, at the instance of the Trustees of the British Museum, proclaimed in 1928 by the Tanganyika Government as a reserve for palaeontological research. Native farming was not to be interfered with; but most of the proclaimed area is, in fact, uninhabited, the soil being poor.

It is now becoming increasingly difficult to locate deposits of bones. Considering the great quantity of bones already sent to the British Museum, and the still larger quantities removed by the earlier German expeditions in the years before the War, this is not surprising. A German report of 1914 stated that exhaustion was already in sight in all accessible localities. Nevertheless, I am inclined to think that with increased expenditure on digging and prospecting there are still good finds to be made.

Though there was formerly a good road to Tendaguru, its maintenance has been abandoned, and when I went up in April 1929 it was a case of pushing one's way through long grass for the greater part of the fifty miles. The direction is fairly straight. On leaving Lindi the track crosses a hill about 400 ft. high, and descends again almost to sea level. Thereafter there is a gradual ascent through Mtutu, Lutende, and Nkanga on to the Noto plateau. The crossing of the plateau takes a whole day. It is waterless, and the elevation is as much as 1400 ft. From the far edge, which is a steep escarpment, Tendaguru hill is seen standing up in the far distance, and a long day's march off. The country is wooded grassland, and the soil is deteriorating, land evidently once farmed being now no longer worth cultivating.

Tendaguru hill, about 850 ft.* high, stands alone. It is scarped all round, and steeper on the north side than on the south. It is covered with grass and small trees, and the flat top is strewn with the pebbles of an ancient river. It commands a fine view over the Mbemkuru valley, and to the small groups of conical hills away to the westward. All around the ground is eroded by watercourses, dry except during rain, and this erosion has worked down to the Lower Cretaceous beds in which are found the bones of the ancient dinosaurs, which have been the objective of the various expeditions.

Although the rains have ceased by April, this month is not suitable for prospecting, the grass being too long, and it is not before July that much burning of the grass takes place. It was therefore only possible for me in the first instance to re-examine old diggings and to see what extensions they were capable of. These extensions proved in several cases productive of good results.

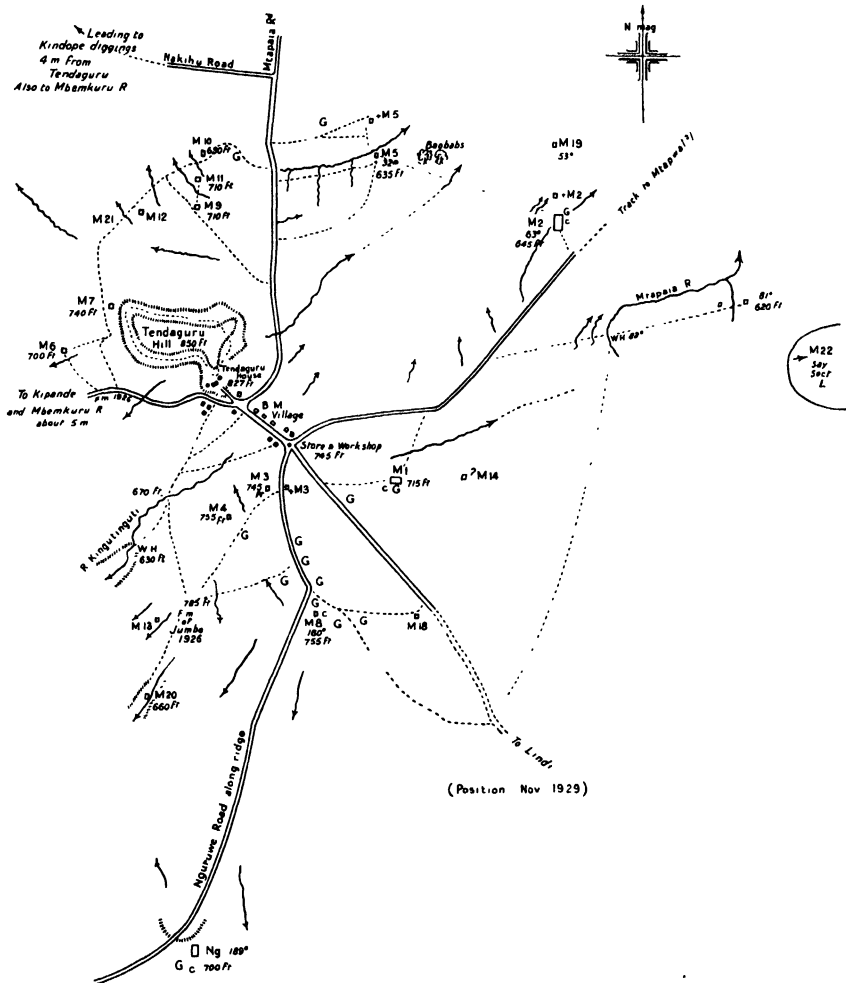
When the excavation of a new area is begun, bones inferior in quality may have to be collected, lest it be not possible later to find better specimens. When, however, a good collection has already been made, more discrimination can be exercised; this applies chiefly to scattered or mixed bones. When a group of bones has been laid bare which are undoubtedly all parts of one skeleton, every fragment may be of value when the reconstruction of that skeleton is eventually to be taken in hand. For this reason no fragment of a bone can be safely rejected. Merely to collect the big specimens for show purposes vitiates the scientific value of the collection. Nevertheless, it is not uncommon to be confronted with bones which are no more than a mass of small fragments, and the reconstruction of which would be impossible.

As to the far past: one may figure to one's self a vast swamp with islands. It contained a luscious vegetation of a type long since vanished, as have the dinosaurs themselves, but unlike them leaving only a scanty record. Trees evidently were not exceedingly numerous, and neither tall nor of great thickness. The dinosaurs that died on high ground or in quiet pools may have remained undisturbed while dissolution was taking place, as may also the carcasses that floated about until stranded, and their bones quietly subsided into the mud as they lay. Such are real treasure-trove. Other groups of bones were scattered

* The heights given in this article are based upon that of Tendaguru House being 827 ft.

by the currents of water, and perhaps washed down into pools. Such groups are naturally very mixed, but even among them may be found the bones of a limb in position. The decomposed

SKETCH MAP OF TENDAGURU 1929



Drawn by F. W. H. Migeod.

TENDAGURU.

Scale: 2 1/4 in. = 1 mile.

body had separated, but the strong muscles had held a few bones together all the while they were being rolled down in a flood water, eventually to be stranded together with bones belonging to other individuals. Examples of this are common in the sand deposits.

Until the material in the Museum is examined it would be

unsafe to say what types of dinosaurs have been found. As far as this season is concerned the principal finds were Sauropods. It may be mentioned that these were vegetation eaters, and were noted for their relatively small heads. The *Diplodocus* in the Museum gallery is an example of what some of them were like. They had long necks, of which the bones were designed to secure lightness. To steady the animal, much of whose time was spent in the swamp water, the dorsal vertebrae as well as those of the tail were solid and heavy, but the latter graded down to a whip-like end. Eighty feet is not an unusual length for a dinosaur. Bulky as they were, and complex in design, and in those respects equal to, or more than equal to, any living things of the present day, they were almost brainless, and a dinosaur of the weight of two or three elephants had a brain smaller than a man's fist; in fact, the spinal cord contained in a single vertebra near the pelvis was larger than the whole brain. That these massive and almost brainless reptilian beasts met a catastrophic end is evidenced by the Tendaguru rocks. There are the remains of some that died long before the great catastrophe. There are also remains of others apparently that survived, and perhaps continued the existence of the species for a considerable period thereafter.

Some two years ago in the vast Lorian swamp north of Kenya there was a similar catastrophe. The sparse rains failed, and the fauna perished in vast numbers. In an area of increasing desiccation the swamp is the asylum for species of all kinds which once ranged far and wide. They are confined to this, the only place where food and water are still left to them. A sudden acceleration of the desiccatory process caused the destruction which an abundance of rain during the following season failed to make good, at least so far as the fauna was affected. The dinosaurs, confined to one fruitful region in a similar period of advancing dryness, would largely have perished, like the hippopotamuses of the Lorian swamp, if there had been a temporary acceleration of the drying-up process, that is, if the sparse rains had failed in any one year, and most of the survivors would have been the flesh-eaters.

At Tendaguru there is an area of some ten square miles in any part of which bones may be found. They are also, but more rarely, to be found further afield. The richest ground is that within a radius of a couple of miles round Tendaguru hill. Could this hill be removed, treasure of the greatest value would no doubt be forthcoming, as this hill stands on top of the deposits. The cost, however, would be prohibitive.

In beginning work one has first to find the stratum one wants. Not always, however, will bones be found even then, for the simple reason that there was not necessarily a dinosaur which decided to die in those few particular square yards. One may be hopeful when one has found some surface fragments. These again may be a false clue. They may have no continuance below the surface, which is usually so if they occur in large quantities and are very fragmentary. They are then the remains left from a stratum which has been washed away by recent rains, and have been left lying on a stratum to which they do not belong. The source, too, of bones in the bottom of a gully is often not easy to trace, and it may have entirely disappeared. The top of the ridge between the gullies was the bone-bearing stratum, and this tapers away in the direction of the flow until it too disappears, the bones falling down into the watercourse below.

Few except the massive limb bones or the very solid centra of the dorsal and tail vertebrae long survive when once the land surface, which is being denuded, has approached their level. First the roots of trees find their way into them, and later those of plants and grasses reach them; and by the time the last have penetrated them the bones cease to have much value as museum specimens. Therefore those buried under hills are in the best condition, but they are hard to locate and harder still to excavate.

Such are a few of the leading indications of the existence of bones, and reasons for their uncertain value when excavated.

On my first expedition I numbered all diggings chronologically as work was begun on them, M 1, M 2, etc., and when more than one skeleton or group of related bones was found on one site they became M 1, No. 1; M 1, No. 2; etc. My predecessor, the late Mr. W. E. Cutler, who died at Lindi, gave numbers to his diggings, but as he left no map, it was not possible immediately to identify the diggings on the ground with the records of his note-books. A few were identified later, but many remained unplaced.

As said above, owing to the impossibility of prospecting at first on account of the long grass, I began by examining the outlying ground of some of the old diggings. M 1 (715 ft.) had produced two skeletons when I first began work at Tendaguru. The site had been opened up by Mr. Cutler to the extent roughly of about 500 square yards and to a depth of two to three feet. Earlier still the Germans had driven a number of straight trenches in various directions on the higher ground on one side,

and these indicated that nothing had been found close by, or there would have been an expansion of the trench at the find. A little way beyond, however, they had found some bones—evidently good ones—for there was one very big expansion; and, to judge from some of the abandoned pieces of bone, the dinosaurs must have been of extraordinary size.

I obtained at M 1, No. 2 some pieces of one of the humeri, which I had been unable to find before, and two or three caudal vertebrae. Further into the rising ground a sandy stratum was reached, six inches to a foot in thickness, which was below the stratum in which the large skeleton (M 1, No. 2) lay. The bones found here were marked M 1, No. 3. This stratum was very wet, and rested on a dark grey, nearly black, clay, also full of moisture, and which emitted a very bad smell when opened up after perhaps millions of years' burial under other strata. On its upper surface were clusters of small shells and lamellibranchs, which would seem to indicate an estuarine deposit. As to the bones in the sand, they were very rotten, and some fell to pieces on exposure. A few, however, were salvaged; the more important were a small femur (2 ft. 8 in. long), largely crystallized (as were other bones), a tibia (1 ft. 5½ in. long), and an ulna (?) (11 in. long), the tibia and the ulna having very attenuated "waists." The vertebrae found only consisted of the solid centrum, the processes having disappeared.

A trench driven out in another direction, though passing through the hard laminated grey stratum that had produced the earlier skeletons, revealed nothing; but a short hundred yards beyond the end of it a drift bone was found, either a humerus or a femur. It must have been a magnificent specimen once, but was so corroded as to be unrecognizable, and in consequence not worth removing. It was probably the last remnant of a skeleton that had been scattered and subjected to the destroying action of air or water, to say nothing of root action. Though the site was excavated to a depth of six feet, nothing was found except some similar unrecognizable fragments just below the surface.

M 2 (645 ft.) had earlier been a site of special interest, to judge from the large accumulation of bones lying in a great bed of sand or sandstone. The bones were largely mixed up, many were fragmentary, while others were grouped in their proper anatomical positions. My new investigations were on the outskirts of this former great mass of bones, but though some more bones were found they were neither of good quality nor of special interest, being all of the same nature as others which

had previously been found. A find of a different kind was a small heap of fish scales, but no fish bones were to be seen; these were in the sandstone. When the grass was burnt it became possible to explore further afield, and on the rising ground which lies between M 2 and the distant M 5 a mass of fragments was examined. They were perhaps forty feet above the bottom level of M 2. An intermediate site (+ M 2) had yielded some pelvic bones in not too good a condition. Here, at what became M 19, the first find was a number of vertebrae just below the surface, with parts of other bones, which from their bad state were unidentifiable. This was especially to be regretted for the reason that, lying so much higher than the great mass of bones at M 2, little more than 300 yards away, and in a different stratum with others intervening, it would have been of the greatest interest to ascertain whether they were the same type of dinosaur, or in what respects they differed. The stratum in which they lay seemed to be a marine one. Digging was continued to six feet down, where a stratum of what looked like red brick-earth was reached. This "brick-earth" I had not come across before at Tendaguru. With it was some mixed-up brown and green clays. There were no bone fragments at this depth.

M 3 (745 ft.) also received further attention. This site had previously produced a humerus 7 ft. long, though the ends were fragmentary, a not uncommon feature with many big bones, and a lower cervical vertebra of great size and seemingly perfect. The new finds, however, were unimportant. They included a scapula ($20\frac{1}{2}$ in. long), heavy for its size, a small claw, a few teeth, and a terminal phalanx five inches across which might belong to the larger individual.

An outside digging (+ M 3), a short hundred yards distant, was begun where a weathered bone showed on the surface. At a depth of two feet fragments of small ribs, etc., a claw and a tooth were found where the stratum changed, and some large bones were reached between four and six feet below the surface. They lay in sand; and already in past ages the ancient stream in the bed of which they lay, a stream either permanent or intermittent, probably the latter, had rolled and worn off all prominences, and then left them buried in its sands as it shifted its course. They were barely recognizable, and so of no value for study purposes. The depth would indicate, as does the nature of the stratum, that they had no connexion with the bone on the surface.

M 8 (755 ft.) was on a rising ground furrowed in all directions

by German workings as well as by Cutler's exploration. The two were always distinct. The Germans dug deep narrow trenches. Cutler preferred wide openings. I had found here in 1926 an almost complete skeleton of a large dinosaur with its tail stretched out as it had been when it lay down to die. The curious feature was that some heavy dinosaur seemed to have set its foot on the tail, and driven four or five vertebrae down into the mud. This skeleton had been missed by the previous excavators, though they had dug within a few feet of it.

This success urged me again this year to look round the edge of the worked ground. In a few days there was promise of something good, and soon a semicircle of vertebrae was laid bare. When completely excavated they were found to be all slightly separated from one another, with a few out of the line. Within the arc were pelvic bones and parts of the fore limbs, but of the hind limbs not a trace could be found. The early promise of a good discovery was entirely dispelled. The bones lay too near the surface, and their condition was disappointing. The outer surface consisted of no more than small pieces a couple of inches or less square, held together by mud, while the inside was a rotten mass that crumbled away. I salvaged some of them by removing a section at a time and gluing the pieces together, at the same time hardening the inner mass with a solution of shellac in alcohol. In this way I retrieved and built up a humerus with unusual features, a coracoid, part of the sacrum, an ischium, and other parts of the pelvis.

I might note here that I almost entirely abandoned the practice of setting bones in plaster in the digging. I preferred to bring them to the workshop, where I could clean and examine them, and then glue together as much as was necessary to prevent the future mislaying of small pieces. If bones are plastered as they lie, one can never study them properly in the short time available, and frequently one finds one wants to refer to them again for some detail. Another not unimportant factor is the increase of weight. A plastered bone often requires a party of men to carry it down for shipment, along a track scarcely traceable until the grass is burnt, and in a big packing-case. Unplastered it can be divided among several boxes of a single head-load weight each; and a big bone is rarely in one piece.

Another old site, the neighbourhood of which I tried again, was M 9 (710 ft.). This was on the north side of a steep ridge, and I hoped by digging into the opposite side of the ridge to make further finds. I had, however, begun operations here

rather late, and owing apparently to the dipping of the stratum the results were negative. The removal of the hill-top on ground which had not proved its value, or given much hint of it, did not seem worth undertaking, though, as will be seen later, I had already had some success in hillside excavation. Still, from M 9a, close to M 9, among other bones came a good metatarsal, some minute ribs belonging to a very small animal of some kind, and a fossil sponge on a stalk.

Along the road to Nguruwe, which for a mile and a half follows a southerly direction along a ridge before it descends into the Mahimbui valley, and so on to a high plateau to the south, was an important site which the Germans had explored. I had not been able to work here on my first expedition, having enough work in other directions; but this season I began early here and continued till the very end of the season. The old diggings (700 ft.) were below the ridge on a plateau of considerable extent which had once been farmed, and where the soil was good enough to warrant it again. I began by driving a trench in a semicircle through the old diggings, and a second one from the far side of a rising ground to the east, bringing it into the principal working. The first yielded some stray bones which had presumably been overlooked before, but the latter nothing, though possibly I did not go deep enough. Where the trench ends met I went downwards, and here found in a sub-surface hollow a pair of hind legs that belonged to a medium-sized dinosaur. The femur, 3 ft. in length, was thick for its size, and the trochanter on its side was but feebly developed. The tibia measured close on 2 ft. and the pubis 2 ft. 1 in. or 2 in. There was a pair of them also. Whilst one leg was remarkably good, the other was considerably decayed in parts, though both were close together. In addition were a number of ribs and vertebrae, but all the latter had their processes broken off. Not far distant a very large pubis was found belonging to another dinosaur. All the bones found lay at one level except the limbs just mentioned, which were depressed below it. This site, which has always been known as the Nguruwe digging, is nevertheless many miles from that village; it is indicated "Ng."

It was not on the lower level, but in the terminal bluff itself above it, where the road ridge ends, that the best finds of the season were forthcoming. After digging without finding a single fragment I decided to work higher up, and after following bone indications round the ridge end, came upon, under the detrital mass in front, the edge of a stratum of dark greenish clay. It

was from two to three feet in thickness, and in this lay the bones which proved of interest and quality. A rib 4 ft. 1 in. long, some 4 in. wide, and with a triangular head 18 in. across, was one of the first finds. More ribs followed and other parts of the skeleton. Progress horizontally was, however, necessarily slow, as the cliff had to be cut away for every foot of advance, and the earth thrown down from above had all to be removed and dumped.

The bones had been very little subjected to running water, many not at all. They had sunk one by one into the mud and been preserved intact, thus affording an almost unique opportunity of studying them. The cervical vertebrae of the Sauro-pods, to which class this specimen belonged, are commonly if not invariably of very delicate and intricate construction. These neck vertebrae, one of which was 27 in. long, were of very delicate construction, consisting of wings and horn-like projections with buttresses, and a cellular formation into which the hand could be passed, the walls being very thin plates of bone. Owing to their fragility they are rarely preserved. Here, however, the conditions had been favourable, and the whole bony structure as the flesh had decayed had been filled with clay, over all being commonly a coating of hard lime. These bones could not with safety be completely cleaned in the field. All that could be attempted was enough to enable their nature to be seen, and to reduce their weight. Their completeness is probably unique in the history of the field, and their final preparation for show purposes in the Museum might easily be a month's work for an expert, the preservation of the bony structure itself being a matter of no little difficulty.

The largest single bone found was a scapula 5 ft. 2 in. in length. Other notable bones were parts of the pelvis, an ulna (?) 3 ft. 5 in. in length, a coracoid, and massive dorsal and caudal vertebrae. Both pubes were found, one at the very last just before closing down. Whereas I had expected them to be of great size, they proved to be no more than 16 in. long, though they had very thick ends. Among short ribs, or vertebral processes, were some two-headed bones without the customary junction of the ends, so that they looked like tuning-forks. There were numerous teeth, but no other parts of the skull could be recognized among the numerous uncertain pieces of bone; and the teeth were widely scattered. One tooth was like that of an *Iguanodon*, but the others were mostly small and had a serrated inner edge, which would show they did not all belong to one individual. Several processes from the lower

part of the tail were found. They were about four inches long and shaped like a human foot and ankle. It was regrettable that the larger bones of both the front and hind limbs were missing, as well as the feet.

Towards the end of the season the deposit showed signs of petering out. I accordingly formed the impression that this was the northern edge of an ancient pool or swamp, and that either the dinosaur had died there, or its carcase had drifted there shortly after death and disintegrated there. Owing to recent erosion only a small part of the deposit was left. The other parts of the dinosaur may therefore be assumed to be irretrievably lost. The only chance of their being found is that a few of them may have slipped out and been recovered by those who preceded me in this locality.

As to the bed itself, this dark green clay in which the bones lie splits vertically. Above this thin deposit, of not more than three feet in thickness, is one of from twelve to fifteen feet thickness, also clay but of a chocolate colour. It contained no indication of life in any form, but I noticed some few concretions all of one type. It nevertheless seemed to be of the same nature as the bed below except for coloration, this chocolate colour having a tendency to percolate the green clay by any fissure it found.

Above this is a marine bed containing belemnites, and possibly representing a creek up which the salt water penetrated, rather than complete submergence. The great thickness of the bed between this intrusion of sea water and the dinosaur stratum indicates that a very long period of geological time elapsed between the passing of the dinosaur and the lowering of the land sufficient to admit the sea.

There are two or three additional features which may be noted in connexion with these deposits. One was the presence not only in the higher strata, but also in the lower ones, of hematite in the form of a deposit on the surface of the bones. Whilst the best preserved bones had this deposit on them, some others did not.

Another feature observed was that running through the green clay, and also to some extent in the chocolate clay, were thin limy plates, set roughly at an angle of 45 degrees. There were also in the chocolate clay more or less vertical lines, a few nearly horizontal, of a greyish earth. These proved to be of recent origin, and represented the decay of present-day roots from trees on the ground above.

As to other diggings: I began early the investigation of a

locality on the head waters of the Mtapia stream, bearing 81 degrees from Tendaguru hill about a mile and a quarter, and height 620 ft. Some largish pieces of bone lay on the surface, and on digging a vertebra and some pieces of rib were found. They lay on the high bank of the stream. At two feet down a soft whitish sandstone was reached, which precluded further finds being likely at a greater depth. A diversion of the trench up-stream met with coloured clays mixed with chalk, but the only bone was a small slip of a rib. It was not worth while continuing here. A couple of hundred yards further up-stream the surface was noticed to be strewn with fragments. The ground was again here opened up, but below the surface was nothing but some crystallized wood. It was apparent that this was the tapering-off edge of a former bone-bearing stratum. Later when the grass was burnt I looked for the "source," and found some bigger bones not far off, and further that the Germans and Cutler also, I gathered, had visited the place; they also apparently found nothing worth removing.

Another new digging was M 18 along the Lindi road and approximating in height to M 8. Here an exposed bone had been noticed. The group to which it may have belonged was generally about two feet below the surface, and a few other bones—ribs—at five feet may have been independent. Their condition was bad, and a humerus 33 to 36 in. in length, and one or two others, were all that were worth taking out. They were of the same type as those so many of which were found at M 2.

M 19 has already been referred to in connexion with M 2.

M 20 (660 ft.): whether the Germans when they worked at Tendaguru published a map of the diggings I do not know. As with Cutler, I had no definite clue to the numbering of the localities worked in. One German site I especially desired to know. It was that of their Sauropod S, which was a nearly complete skeleton. Overseer Boheti, who had worked with the Germans and still works for the British Museum, said he could find it after I had shown him a picture of the work in progress, and led me to a site down a steep ravine due south from Tendaguru about a mile. Though the space at the bottom was very confined, I tried the ground in three places lower down the gully. It is thickly overgrown with small trees, and near the German site are two baobab trees, perhaps 70 to 100 years old. On the first trial the edge of a green stratum was exposed in the hillside, but the only bones found were a few pieces of a rib or vertebral process rather water-rolled. A bright green clay,

which I had not met with anywhere else, also appeared here. There was not, however, sufficient inducement to justify digging into a hundred-foot, almost vertical hillside. Belemnites, however, occurred in a bed of uncertain position above, and had fallen down in the detritus. The other trial diggings only showed detrital earth.

The next new digging, M 21 (about 700 ft.), was in a different direction, being on the western side of Tendaguru hill, in a locality strewn with fragments. The vertebrae were amphicoelous. A small femur, 2 ft. long, a pelvic bone, and a massive metatarsal were among the bones worth removing. There was also fossil wood, and some belemnites. All the finds were on the surface, thus indicating them to be derived from a lost stratum.

The last find of the season, M 22, was made a couple of miles easterly from Tendaguru hill. It consisted of the bones of a foot in association. Up till then all foot bones I had collected had been dispersed ones.

On the Mtapapa river there is an escarpment about 100 ft. high which is of use for checking the strata, though not all are represented. This particular escarpment, about $1\frac{1}{2}$ miles from Tendaguru hill, along the track past M 2, shows up mostly red in colour. About 20 ft. up a grey stratum crosses it, in which was found a piece of dinosaur bone, indicating it as a bone-bearing stratum. Another 20 ft. or more up was another and thinner streak, which I could not examine. Higher still was an apparently marine bed. The conformation thus corresponded roughly with "Ng. Bluff" about four miles away, and confirms that there was a long period of deposition, which was lifeless, between the destruction of the dinosaurs and the arrival of the sea up the rivers or creeks.

I found this season some more pieces of quartzite with natural fractures caused by fire when the grass is burnt. These stones approximate very closely in appearance to artefacts of the Mousterian type in the same material. The various forms taken by the natural fractures are not without interest. All the collected specimens lay on the surface. I found none below.

In addition to the palaeontological work, I was able to add to the botanical collection I made on my first expedition.

A few administrative notes may be added in conclusion. The bones are packed for transport to the coast and England in kerosene boxes. They are iron-bound, and go down in small batches weekly. Naturally for the first two or three months there is not much to send. In the past these boxes were put two or three together into large packing-cases of one-inch wood.

I discontinued the practice this year; one reason being that, being alone, I had nobody at Lindi to do the work, and these cumbersome cases were difficult to handle both at Lindi and in England. The iron binding alone gave the additional strength required; and the boxes arrived safely at the Museum.

Funds were insufficient to provide for a European assistant. As to the native labour, on which so much depends, this was satisfactory in quantity, the output of a maximum of forty men being as much as could be handled. The principal drawback is that so many want to leave at the end of the month, and it is often a week before the full strength is forthcoming again. Few men remain more than three months, by which time, at the local standard rate of 18s. a month, they reckon they have earned enough to pay their taxes and buy some cloth to go home with. Even those on higher rates do not stay if their friends are leaving. As the work of the majority must necessarily be carrying the dirt bowls from the digging to the dump, three months at this is usually enough for all except an enthusiast. They have worked very well generally, and during the whole season there have been no cases of absence from work nor of taking days off. It has been found simplest in the past immediately to invite a labourer who does either to go and look elsewhere for work on the lines he desires; and the tradition remains. There are no inhabitants for some four miles from Tendaguru, and no distractions except a trip, in turns, to the port of Lindi, fifty miles off, with the boxes of bones for shipment. On Sundays, however, they go and buy their week's food in the distant farms, as few farmers take the trouble to bring or send anything for sale. Sickness has been nominal. A 48-hour week has been kept.

Some previous articles on the Tendaguru dinosaurs have been written by—

Mr. F. W. H. Migeod : *Natural History Magazine*, April 1927 ;
African Society's Journal, July 1927.

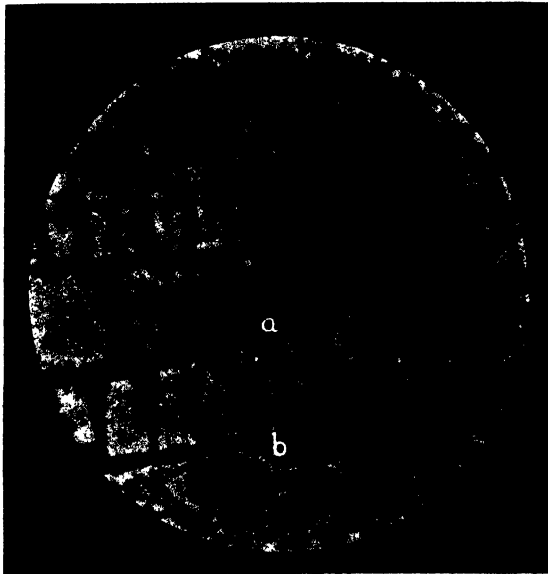
Dr. J. Parkinson : *Natural History Magazine*, October 1928.

Dr. F. L. Kitchin : *Geological Magazine*, May 1929.

THE MARKINGS ON THE DIATOM COSCINODISCUS.

By E. H. ELLIS, Clerk, Department of Botany.

DIATOMS have long been favourite objects for study by amateur microscopists, largely because of their association with the optical development of the microscope. Most forms exhibit a periodic structure, and owing to the varied appearance with different optical adjustments there has been considerable discussion in the past on the true nature of the markings. Many



TRANSVERSE SECTIONS THROUGH TWO SPECIMENS OF
COSCINODISCUS.

The lower section is median and shows the top plate
(a) and the bottom plate with the central gap (b).

ingenious attempts have been made to solve the problem, including the recent contribution by Dr. J. A. Murray, where the diatom is allowed to absorb gelatine which is then stained with Heidenhain's iron-alum hæmatoxylin, a method essentially similar to the "charging" method introduced by Houghton Gill in the nineties.

The diatomist Van Heurck based his opinion on the markings largely on a number of sections prepared by Flögel, and it is obvious that where this can be done the result is decisive. The small size and siliceous material of diatoms, however, precludes this for the large majority of species owing to difficulties of manipulation.

The so-called "Cementstein," an Eocene diatomaceous deposit of Mors Island, Jutland, contains the well-known diatom *Coscinodiscus*, and hence rock-sections prepared in the ordinary way show many individuals in section; a photomicrograph ($\times 1600$) of a *Coscinodiscus* in tranverse section so obtained has recently been presented to the Department of Botany by Mr. C. H. Caffyn. When the diatom is seen from its upper surface it apparently consists of a number of hexagonal markings, in the centre of which, if the microscope is focused down slightly, a smaller circle can be seen. These two markings are on opposite sides of the valve and show the limits of thickness of each "cell." The section reveals the true nature of these markings. There is a top plate which bears the well-known secondary markings, and a bottom plate with a central gap at the entrance to a hollow chamber with slightly tapering walls.

RECENT IMPORTANT ACQUISITIONS.

HIS Majesty the King has placed on loan in the Department of Botany 267 specimens of dried plants from Nepal. These plants were presented to His Majesty by Colonel His Highness Maharaja Sir Bhim Shumshere Jung Bahadur, K.C.S.I., K.C.V.O., Prime Minister and Marshal of Nepal, who had them collected by Captain Lall Dhevoj with seeds, with a view to their being suitable for growing in the Royal parks and gardens. The collection is of special value in the Museum because of the lack of material from Nepal, only a very small area of which has been explored botanically.

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Amongst recent accessions to the Exhibition Galleries are six photographs of East African elephants taken by Mr. Marcuswell Maxwell and presented by the proprietors of *The Times*. These photographs are quite as fine as any of the reproductions of Mr. Marius Maxwell's work exhibited on the walls of the Museum. One photograph shows an old bull elephant at close quarters, standing by the side of some water with its trunk held aloft; another picture, also taken by the water, shows a baby elephant having a bath with the assistance of an adult member of the herd. There is an exceptionally good photograph of an old elephant advancing to the attack, with head up and ears widely extended. Some of these photographs are placed on exhibition in the Central Hall, and others in the Lower Mammal Gallery. They make a most interesting addition to the collection of photographic records of animals in their natural surroundings.

A young Grant's Zebra (*Equus quagga granti*), recently received from the Rowland Ward Trustees, makes an attractive addition to the collection of zebras in the Lower Mammal Gallery. The specimen is quite a young foal and is the first baby zebra presented to the Museum as a mounted specimen for the Exhibition Galleries.

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Department of Zoology.

Stuffed specimen of a Giant Tortoise; presented by the officers of the Royal Artillery at Mauritius. This is a most interesting acquisition, not only

because it is the type of the species *Testudo sumeirei*, but also because the history of this animal, which was known as "Marion's Tortoise," is recorded from the year 1766, when it was brought, along with four others, to Mauritius from the Seychelles. It is said to have been specially mentioned in the treaty by which Mauritius was ceded by France to Great Britain in 1810, and it lived at the Artillery barracks at Port Louis until its death by accident in 1918.

Collection of birds; purchased. This collection of about 300 specimens, belonging to about 80 different species, was formed by Mr. G. L. Bates during a trip in 1928 in a part of the interior of West Africa through which no ornithologist had previously travelled. Leaving Lagos early in March, Mr. Bates went by train to Jebba and thence proceeded up the Niger to Say. Here he left the river and marched south-west through a semi-arid region covered with thorny scrub to Fadangurma on the Haute Volta and then on to Wagadugu, which place he reached on May 24. Turning north-west he marched to San and then made for the Niger, striking that river at Kulikuro in French Sudan on July 19. Seven days later he reached Bammako, whence he went by rail to Dakar. Though this collection has not yet been properly worked out, it is not expected that it will yield any novelties, but it is of great interest from the point of view of the range of distribution of the various species collected.

Female specimen of the rare squid *Sthenoteuthis caroli* stranded at Filey Bay on January 9; purchased. The Department has for several years been collecting specimens and data as to strandings of large squids in the British Isles. A high percentage of these strandings occurs on the Yorkshire coast in the neighbourhood of Scarborough.

The very extensive and valuable collection of skeletons formed by the late Mr. E. T. Newton, F.R.S.; purchased. This collection was formed to serve as a standard of comparison for Mr. Newton's studies on fossil vertebrates. Most of the skeletons were prepared by Mr. Newton himself and give evidence of his unusual skill as a preparator. There are over 1000 skeletons of mammals and birds besides a considerable number of skeletons and skulls of reptiles and fishes. A particularly valuable section is a carefully determined series of the otoliths or ear-bones of fishes. These otoliths from their hardness are often the only remains of fishes found in a fossil condition, and Mr. Newton's collection has frequently enabled geologists to determine remains that would otherwise have been quite unrecognizable. The bird skeletons will form a very valuable addition to the Museum collection, in which at present many common species are unrepresented or represented only by imperfect skulls or bones. It should perhaps be mentioned that the Newton Collection, consisting as it does of unmounted skeletons, will be available for study and research and that no part of it will be placed in the Exhibition Galleries.

Department of Entomology.

A large collection of insect-galls and gall-makers from various localities in Great Britain; presented by Prof. A. C. Seward, F.R.S. The plants upon which the galls were found belong to some 28 genera: fir, oak, poplar, willow, elm, hornbeam, birch, beech, alder, sycamore, lime and ash are the chief of the forest trees; the fruit trees include cherry, walnut, almond and peach; and among cultivated plants may be mentioned ferns, roses, violets and rhododendrons. Many of the specimens, often labelled with remarks as to their rarity or otherwise, date back nearly to 1860, when both in this country and abroad the study of galls was in its infancy. A correlation of these early records with present-day knowledge should therefore render it possible to form some idea of the way in which many species of gall-makers have extended their range.

A collection of about 10,000 insects of various orders from British Guiana; presented by the Oxford University Expedition to British Guiana. The purpose of the Expedition was to study life in the upper levels of a tropical forest, and the collection is of special interest because it was made almost entirely in primitive jungle, as distinct from second-growth forest, and includes some five hundred or more specimens which were obtained in trees at heights of from 60 to 100 feet.

A series of bot-fly larvæ from the throat of an elephant killed at Masindi, Bunyoro, in August 1929; presented by Capt. C. R. S. Pitman, D.S.O., M.C. Including the species (*Pharyngobolus africanus*) to which these specimens belong, the African elephant is infested by the larvæ of five different kinds of bot- and warble-flies; the maggots of one of these species (*Neocuterebra squamosa*—a warble-fly) have the remarkable habit of burrowing in the soles of the ponderous animal's feet.

The value that the common pheasant may sometimes possess from an agricultural point of view is illustrated by a series of 243 larvæ, or grubs, of the St. Mark's fly (*Bibio marci*, Linn.) found in the crop of a hen pheasant, and presented by Mr. Mark Crapp, of Liskeard. The larvæ of the various species of *Bibio*, of which a number occur in this country, live in colonies in the soil and do a certain amount of damage to the roots of grasses and other plants. In the Central Hall of the Museum, in a case of "Birds Beneficial to Agriculture," there is exhibited a series of *Bibio* larvæ which, to the number of no fewer than 626, was taken from the crop of a pheasant, shot near Horsham, Sussex, on January 16, 1918.

A small collection of British Lepidoptera, formed by the late Mr. Maurice Wrightson in the neighbourhood of Clacton-on-Sea, in excellent condition and provided with full data; presented by Mrs. A. M. Wrightson, the collector's mother. This series of specimens will prove a useful addition to the distributional collection of British Lepidoptera now in process of formation.

A collection of 1362 Tiger-beetles from all parts of the world; presented by Mr. H. E. Andrewes. This is a further instalment of his gift of his great collection of Coleoptera, of which more than 37,000 specimens have so far been received, a considerable number being the types of species new to science.

A valuable collection of Coleoptera and Hymenoptera from the Algerian Sahara, numbering 1224 specimens and including the types of several new species; presented by Dr. Ernst Hartert.

A series of water-colour drawings of North American Lepidoptera; presented by Mrs. Isabel Geffcken. The drawings were made by her father-in-law, the late Mr. Waldemar Geffcken, between 1873 and 1888; 1914 in number, including studies of 847 moths and 1067 butterflies, they are of great beauty, and are remarkable for their truth to nature no less than for the artistic skill with which they have been executed.

A set of 12 enlarged photographs, showing locust control in Transjordan by the Palestine Locust Service; presented by Mr. G. E. Bodkin.

A specimen of *Anthrax anthrax*, a striking-looking jet-black fly caught in September last near Leicester by Mr. P. A. Muschamp; presented by the Leicester Museum and Libraries Committee. This donation is noteworthy, since the species, though widely distributed on the Continent, has not hitherto been recorded as occurring in the British Isles.

Department of Geology.

Collection of British fossils; bequeathed by the late Mr. G. W. Young. The specimens were largely collected on the excursions of the Geologists Association, of which Mr. Young was a past-President.

A complete ichthyosaur on a slab of Lower Lias limestone from Street, Somerset; presented by Dr. W. Cunningham.

British fossils from the collection of the late Mr. E. T. Newton; purchased. The most important of them is a series of Pliocene mollusca from the St. Erth beds. These beds consist of two small patches near the village of St. Erth, in Cornwall, and are remarkable for being the only known English beds of Pliocene age lying west of Kent and East Anglia. The fossils occur in clay underlying sand and gravel, and unless, as has only occasionally happened, this clay is opened up for some special reason, the fossils are unobtainable. They are consequently rarely met with.

A large series of echinoderms of Permian age, among which the bud-like blastoids are particularly well represented, and a very large number of Permian brachiopods, of Triassic ammonites, and of Tertiary gastropods and lamelli-branches; purchased.

Department of Mineralogy.

Crystallized tarbuttite from the new workings in Kopje No. 2 at Broken Hill, Northern Rhodesia; presented by the Rhodesia Broken Hill Development Company.

Sheets of mica from the mica mines, Batoka district, Northern Rhodesia; presented by the Secretary of Mines for Northern Rhodesia.

A fine block of rose-quartz from South-West Africa; presented by Mr. E. G. Bryant.

A large series of rocks collected by the donor in the Transvaal, and a large series of minerals, including hematite and pyrites, and rocks collected by him from the salt-plugs in Laristan, Persia; presented by Mr. J. V. Harrison.

Nitre collected by the donor in the McDonnell Ranges, Central Australia; presented by Sir Douglas Mawson, O.B.E., F.R.S.

Crystals of bismutotantalite, a new mineral from Uganda; presented by the Director of the Geological Survey of Uganda.

Probertite, a new borate mineral from California; presented by Prof. F. H. Probert.

Larnite, a new mineral from Larne, Co. Antrim; presented by Dr. C. E. Tilley.

A polished and etched slice, weighing 7400 grams (16 lb.), of the meteoric iron found in 1915 near Gladstone, Queensland; a large slab of crystals of chabazite from Kyogle, New South Wales; fine crystallized specimens of lead-ores (anglesite and mimetite) from Tsumeb, South-West Africa; and a series of rocks from Sardinia; purchased.

Department of Botany.

Specimens of Myxomycetes; presented by His Majesty the Emperor of Japan.

A collection of about 12,500 slides of diatoms; bequeathed by the late Mr. Wynne E. Baxter. The main portion of the collection is arranged in book boxes, which are catalogued and numbered serially. This contains nearly 5000 slides from the famous collection of Frederic Kitton and also many of the classic sets of slides prepared by noted diatomists. Another set of slides forms a separate type collection arranged according to Van Heurck's Treatise on the Diatomaceae, which was translated by Baxter in 1896; this set will be kept intact for the use of students as a standard set of slides. This bequest notably augments the Museum's collection of diatoms, which was already both in historical value and in size the most important in existence.

The large and valuable herbarium of the late Mr. C. E. Salmon; bequeathed. It is not at present possible to give a close estimate of the number of plants, but it is at least 60,000. Mr. Salmon was one of the best known British botanists, an authority on certain genera and on the distribution of British plants. At his death he had almost completed a Flora of Surrey. His herbarium therefore contains the foundation of much recent work on the British Flora. In addition to plants either collected or received by him, the herbarium includes several important collections, of which the most noteworthy are those of Arthur Bennett (exclusive of Potamogeton, the British specimens of which are already at the Museum), A. W. Bennett, and H. T. Mennell.

The herbarium of the late Mr. A. A. de Carvalho Monteiro; purchased. This consists of about 4500 sheets and is a valuable addition to the European Herbarium because of the previous absence of a really good series of Portuguese plants. It contains many specimens collected by botanists who have written on the Portuguese Flora.

BOOK NOTICES.

Snakes of Australia. By J. R. KINGHORN, with a foreword by HEBER A. LONGMAN, Director of the Queensland Museum. Pp. iv + 198, with 137 figures in colour and 8 figures in monochrome. 1929. (Sydney: Angus and Robertson. 10s.)

THIS book consists essentially of two parts. The first describes briefly the diagnostic features of snakes, their natural history, venom and its effects, and the preparation and uses of antivenines, and recommends a rational method of first-aid treatment in cases of snake-bite. The other is designed, by means of "keys," brief descriptions and numerous coloured illustrations, to render the identification of any Australian snake a comparatively simple matter. The treatment of so large a subject in so small a space obviously cannot be monographic; but the book should be exceedingly useful to the traveller and field-naturalist, and the specialist will appreciate the publication of a complete list of the Australian snakes. The absence of references to any more complete descriptions will prove a handicap to the serious student, and one can but deprecate the insistence on the value of permanganate of potash as a remedy in the treatment of snake-bite. The unqualified statement that it "is an absolute antidote, a killer of venom once it comes into contact with it," is very misleading; permanganate of potash, like many other powerful oxidizing agents, destroys venom *in vitro*, but many experiments have demonstrated that it is of little, or no, use *in vivo*.

Big-Game Photographs from "The Times." Photographs by Mr. MARCUSWELL MAXWELL taken in Kenya and Tanganyika. Foreword and twenty-eight plates. 1929. (London: The Times Publishing Company, Ltd. 5s.)

THE remarkable photographs in this volume have already been reproduced in *The Times* of last year; they are now made available in book form with the above title. Enlargements of eleven of the best of the series of photographs have been presented to the Museum by the Proprietors of *The Times* and are now on exhibition in the Lower Mammal Gallery.

In a one-page foreword we learn that Mr. Marcuswell Maxwell was a novice at big-game stalking; from his results it is evident that he enjoyed to the full

the luck of the beginner. Possibly the magnificent work of his namesake, Mr. Marius Maxwell, a pioneer at stalking big game with a camera, had not a little to do with stimulating Mr. Marcuswell Maxwell to produce such good material. The lion photography was conducted from a car; presumably the lions depicted are the much-photographed members of the Serengete pack in Tanganyika. There are nineteen illustrations dealing with the lion, five of these representing a group of lions under a thorn tree. In three of these pictures a lion is to be seen at rest on a bough of the tree about eight feet from the ground, and in another plate a lion, apparently the same one, is photographed in the act of climbing the tree. In still another of these illustrations we see a further view of this tree-climbing lion. At first glance at these photographs one is apt to think that Mr. Marcuswell Maxwell's lions are as arboreal as leopards; on a closer inspection, however, it will be seen that in all five instances it appears to be one and the same animal that has developed this tree-climbing habit. There are some excellent photographs of lions at a zebra-kill, the body of the zebra having been towed to the scene of operations behind the photographer's car.

Following the lion series are four snapshots of the black rhinoceros, in one of which the attendant tick-birds are shown busily engaged in feeding on the vermin living on the vast body of their host. This association, which resembles that of the starlings and sheep, may perhaps be regarded as a case of partial symbiosis, the two animals existing together in a state of harmony and mutual satisfaction; the tick-birds, on the one hand, gain in that they are liberally supplied with food, and the rhinoceros, in addition to having a number of very alert sentinels on its back, is doubtless not averse to parting with some of the more penetrating members of its invertebrate and uninvited guests. Thus we see that both the partners of this curious association reap distinct benefits from the same.

The volume concludes with two good giraffe pictures, a very fine study of a herd of African buffalo, a portrait of two wart-hogs, and a scene round a water-hole. The only grumble one has to find with this very charming publication is that neither the pages nor the plates are numbered, so that reference to any particular illustration is a matter of some difficulty.

The Boston Society of Natural History, 1830-1930. Pp. xii + 117, with 39 figures. (Boston: printed for the Society. 1930.)

IN this little work is given a brief account of the more salient features of the history of the Boston Society of Natural History. It held its first meeting in February 1830, and consequently has now completed an existence of one hundred years. Its career has been one of the long struggles with financial difficulties and inadequate resources that appear to be usually characteristic of bodies concerned with natural history. Nevertheless, by the year 1860 the Society had so far developed that the State was moved to give it the land for its existing home, and thither it transferred from a hall which at its inception it had rented over a Savings Bank. At the present time that building, despite its subsequent rearrangement and the reorganization of the collections, is far too small for the Society's needs and is, moreover, far from fireproof. A more ambitious edifice, of which a drawing is shown on p. 112 of the book, is in contemplation, and possibly it is hoped that the issue of the book may stimulate the flow of funds.

The book has three sections: Milestones; The Museum as it stands Today; Plans for the Future. The cover unfortunately bears the title of the first section with the addition of the period 1830-1930—instead of the one

which we have taken from the title-page. The book is well and amply illustrated, mainly with portraits of officers or others closely connected with the Society. We note that the Boston Museum is devoted to the exhibition and study of the geology, fauna, and flora of New England, exotic collections being left to the neighbouring University Museum in Cambridge. In spite of all that the Society has done for Boston and New England, the State has supported it only by the gift of the site of the Museum; for its maintenance it has had to look to private liberality. Inasmuch as the importance of museums to the community is being increasingly recognized throughout the world, it may be anticipated that eventually the Museum at Boston will obtain the funds that it requires for its enlargement and maintenance.

Wild Exmoor through the Year. By E. W. HENDY. Pp. 320, with 25 illustrations by A. CARRUTHERS GOULD, R.B.A., R.W.A. 1930. (London: Jonathan Cape. 10s. 6d.)

"Wild Exmoor through the Year," by Mr. E. W. Hendy, is a book which deals with the wild life of Exmoor in some detail, the story of the birds and animals of the district being told month by month; it is profusely illustrated with sketches by Mr. A. Carruthers Gould, whose work adds to the charm of the volume. The greater part of the tales have already appeared in various periodicals; they lose little or nothing for re-telling, and the author and publisher are to be congratulated in getting together so much that is attractive and interesting.

In the first chapter, entitled "The Turn of the Year," there is given an account of feeding wild birds during winter months, and the number of different birds that visited Mr. Hendy's "tables" is quite noteworthy. Four of these "tables" were provided, three close to Mr. Hendy's house and the other one some distance away in the garden. At the last one the shyer and more nervous visitors were to be met with; such birds as rooks and jackdaws, and even a kestrel, were seen feeding there. Some of these feathered folk were short of a leg, others had injured wings, while a case is mentioned of a jackdaw which had been badly in the wars, having a stiff wing and only a short part of its upper jaw remaining; that a bird suffering from such an injury could still feed is remarkable.

There is an interesting account of the crossbill accompanied by an illustration of three of these birds feeding amongst the boughs of a larch tree. The second chapter deals with birds' eyes, the various colours of the eyes being dealt with in detail. Mr. Hendy notes that the hawfinch has eyes of a beautiful vinous red colour, and points out that such illustrations as show the eye to be grey have either been done from dead birds or stuffed specimens. In addition to the usual dark brown iris we meet with the ruby red eye of the Dartford warbler, the vermilion eye of the golden oriole, and the green eye of the cormorant; the last named do not become "little yellow gods" until they are a year old, the eye in the young bird being greyish. In the third chapter there is an entertaining tale about the squirrel, or "little red man," and the cuckoo, which is referred to as a mendacious bird, is here stated, (that is, in the month of February), to have begun its career of fraud and deception, at least in the popular press. The author refers to the inevitable small boy in his neighbourhood "who can (and does) imitate this immoral bird's note to the life: no doubt the same gentle art is exercised with equal perfection in other parts of the country." Concerning this statement one recalls with a lively feeling of amusement the late Richard Lydekker's experience with an early cuckoo;

how, after reporting having heard the cuckoo early in February, he was forced to admit that the call he heard was none other than that of a clever but evil-minded boy, and for weeks after the incident this worthy zoologist was receiving cuckoo clocks and other reminders of the affair.

Badgers occupy a considerable amount of the fourth chapter, "Moods of March"; these animals are said to be common enough on Exmoor, but, as in most other parts of the country, they are rarely seen unless one goes specially in search of them. Badgers, of course, are to be found quite close to London, but owing to their retiring habits they are very rarely observed. In chapter five we have an account of the dipper, and in six, entitled "April Advances," the author has something to say on the question of stag-hunting, which he supports because he believes that its discontinuance would inevitably mean the extinction of the wild red deer on Exmoor. This chapter also contains information about the rabbit and fox. An incident of an unusual nature is related concerning the rabbit, which indicates that bunny is not always as timid an animal as he is supposed to be. One morning in April Mr. Hendy observed a rabbit attack a stoat, butting the stoat with its head until the latter beat a retreat; as the author observes, probably the rabbit was defending its young, but the mode of attack was curious. There then follows an interesting chapter devoted to bird protection, and chapter eight deals with "May Days and Nights." In the latter an account is given of two carrion crows that were seen to fly on to the back of a stag and there commence pecking away energetically, doubtless feeding upon the vermin parasitic upon the beast, in the same way as starlings feed on the ticks of sheep. A similar state of affairs is met with in connexion with the black rhinoceros of Africa, which is frequently accompanied by a party of keen-sighted tick-birds, which, much to the sportsmen's disgust, will often give the alarm long before the rhinoceros is aware that anything unusual is occurring.

Chapter nine deals with the nightjar, and the love-making of these birds in the half-light and shadows of the evening is described in some detail; and chapter ten, dealing with the month of June, is termed "The Hungry Month." There follow chapters on the Exmoor merlins and "July in the Coombes"; in the latter we have an account of some of the hawk-moths and a figure is given of the death's-head hawk-moth. The convolvulus hawk-moth is spoken of as a rare visitor, and the visits of the humming-bird hawk-moth to a bed of phloxes are noted. That this latter moth is attracted by the colour of flowers would seem to be abundantly proved by the manner in which it seeks out all the highly coloured flowers; a case is on record of one of these moths paying repeated, but somewhat unprofitable, visits to a brightly coloured post on a croquet lawn. The chapter on stag-hunting (XIII) deals with this vexed question somewhat exhaustively, the chapter ending with a suggestion that "if and when our high-brow humanists have succeeded in stamping out the wild deer on Exmoor," a commemorative monument should be erected with a suitable inscription. After dealing with the whole matter in some detail and showing himself to be a strong supporter of the killing of deer by hunting, the author concludes his chapter with the following epitaph:

To the Memory of
The Wild Deer of Exmoor
Exterminated
In the Name of Humanity.
O Humanity, What Crimes Are
Committed in Thy Name!

STAFF NEWS.

THE Principal Trustees have appointed Mr. Arthur Garfit Alston, B.A., Assistant Keeper (Second Class) in the Department of Botany, and Mr. Alexander Cockburn Townsend Assistant Keeper (Second Class) in the Library.

Mr. Alston was educated at Marlborough College and at Lincoln College, Oxford. He obtained second-class honours in the School of Natural Sciences (Botany) in 1924. From 1925 to the date of his appointment at the Museum he was systematic botanist to the Department of Agriculture, Ceylon. Mr. Townsend was educated at St. Paul's School and at Magdalene College, Cambridge. He obtained second-class honours in the Classical Tripos in 1926 and in the Modern Languages Tripos in 1928. He was awarded the Peskett Prize for Modern Languages in 1928.

* * * * *

Mr. Thomas James Dudley has been appointed Hall Superintendent in succession to Mr. Frederick Wonnacott, who retired on March 13 after more than 38 years' service.

* * * * *

Mr. F. W. H. Migeod has been appointed leader of the British Museum East Africa Expedition for the 1930 season. He will be assisted by Mr. F. A. Parrington, B.A., Assistant Superintendent and Strickland Curator, Museum of Zoology, Cambridge. They left England on March 20.

* * * * *

Mr. Thomas Wells, Higher Grade Clerk in the Bird Section of the Department of Zoology, retired on April 2 after the completion of forty-seven years spent in the service of the Trustees of the British Museum. He entered the Museum as a Boy Attendant (on the old establishment) on April 2, 1883. At that date the Zoological collections had not been removed to the Natural History Museum at South Kensington, and Mr. Wells in his early years at the Museum assisted in the arduous task of transferring to the new building the cabinets containing the collection of Birds. He is the last member of the staff who began his service while some at least of the Natural History collections were in the old building at Bloomsbury.

CORRIGENDUM.

P. 166, in Fig. 1 the "Nandi Bear" skull is the upper one.

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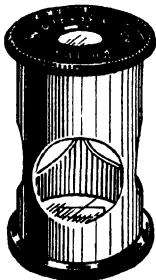
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Natural History Magazine

No. 15

JULY, 1930

Vol. II

FOSSIL HUNTING IN MADAGASCAR.

By ERROL I. WHITE, Ph.D., Assistant Keeper, Department of Geology.

THE island of Madagascar is possibly one of the most unfamiliar regions in the world to the average Englishman. A French colony, lying somewhat off the main trade-routes both to the East African Colonies and to the Orient, it is but little noticed by the commercial world, and, containing no big game, it does not attract the sportsman; yet to the scientist it is of the greatest interest. Only 250 miles distant from the east coast of the African mainland, it shows a most striking individuality in both its fauna and its flora. Not only do we miss the herds of elephant, rhinoceros, antelope, buffalo, giraffe, zebra, and the attendant carnivores—lion, leopard, hyæna, jackal—in fact, all the beasts that characterize the African landscape, but we also fail to find true monkeys or baboons, their place being taken by the more beautiful but less intelligent lemurs, with longer and more fox-like muzzles. A species of pigmy hippopotamus lived formerly in the island, but is now extinct, though only comparatively recently as geological ages go, and with it there lived giant lemurs, as big as men, and huge flightless birds (*Æpyornis*), like large cassowaries. Some of these birds reached a height of 11 feet, and their eggs were proportionately large; an egg in the Department of Geology has a maximum circumference of 3 feet and a liquid content of about 3 gallons, and is equivalent in size to 6 ostrich eggs or 148 hens' eggs. Fragments of the shells are commonly found in the sands along the west and south coasts of Madagascar, although complete specimens are rare; but in the interior of the island even fragments are seldom found, and it is therefore supposed that the birds made a seasonal migration from the highlands to the coast in order to lay their eggs. *Æpyornis* eggs were famous as curios long before the bones of the bird were discovered; indeed, it is not improbable that the chance discovery of one of these eggs by some early adventurer gave rise to the story of the Roc of "Sindbad the Sailor."

With the *Æpyornis* there lived another flightless bird, *Mullerornis*, of slenderer build than its gigantic contemporary.

Mullerornis is of much scientific interest, especially as regards its pelvis and skull, both of which are incompletely known.

It seems that these great birds and lemurs, as well as the pigmy hippopotamus, became extinct within comparatively recent times, and it is even possible that their final disappearance was brought about by human agencies; for in Malagasy folklore are stories of encounters with monsters, such as the "Sòn-gòmpy," the "Làlomèna," and many others. Moreover, Flacourt, the French explorer of the seventeenth century, gives these names in a list of Malagasy animals, without, however, stating that he had seen them himself, and natives still apply these names to the fossil bones when they happen to find them.

The remains of *Æpyornis* and its contemporaries occur chiefly in former lake-basins and in river-beds in which the blackish marsh and other alluvial deposits vary in depth from two or three feet to as much as fourteen feet. The bones, which are invariably disarticulated and never associated as complete skeletons, are found at all levels, but appear to be in some sort of sequence, which, however, does not hold good over more than a restricted area. In the south-west the bones of hippopotamus, crocodile and giant tortoise are abundant at all depths except in the surface humus, but the bones of the lemurs and the great birds are more or less confined to the deeper levels, below a thick white calcareous bed which is everywhere present in the region and is sometimes represented by a bed of hard travertine that greatly increases the difficulties of working the deposit. In the central highlands, on the other hand, the white layer is absent, the lemur remains occur at all depths, and the other animals are chiefly confined to the lower parts of the deposits (*vide* H. F. Standing, 1908, *Proc. Zool. Soc.*, XVIII. p. 65). The bones are often remarkably fresh in appearance, and a few instances are known in which soft tissues such as the ligaments have been preserved.

Madagascar is nearly 1000 miles long from north to south and 350 miles at its widest, and has an area of 228,000 square miles. It is thus approximately equal to the combined areas of France, Belgium, and Holland. A considerable range of mountains and uplands runs along its length, for the most part close to the east coast, but spreading out to fill the northern extremity and to form an elevated central plateau which falls away gently to the lowlands of the west and south. As a result of the easterly position of the watershed the main drainage system is westerly towards the Mozambique Channel, but although some of the rivers are of no mean size—

both the Bétsibòka and the Mangòky exceed 200 miles in length—they are of little practical use owing to the seasonal variation in level and the frequency of sand-bars in the lower reaches.

At one time the country was well wooded, but now the forest is restricted to a dense and continuous belt of varying width along the mountainous east coast and to isolated areas along the west coast. The disappearance of the forest is undoubtedly due to the heedless and often wilfully destructive habits of the natives, who will without a second thought hew down a 20- or 30-foot tree for the sake of the honey in a bee's nest near the top, or light a fire among the roots to cook their midday meal of rice. Fire, indeed, is the chief enemy of the Malagasy forests; every spring the grass is burnt off to "improve the pastures," and each spring the fires eat farther and farther into the woods; and the Malagasy, mindful only of their immediate needs, watch with indifference and even with pleasure the disappearance of one of the island's greatest assets and the chief source of its beauty and interest—for with the forests disappears the greater part of its unique animal life.

Madagascar has a wide range of climatic conditions. Over the greater part of the island the climate is tropical, but in the central highlands it is much more temperate, as may be imagined from the general elevation of three to five thousand feet; and sometimes during the cool and dry months from June to August the prevailing south-easterly wind is bitterly keen.

The geological structure of the island is relatively simple. Two-thirds of the island, comprising all the highland region from north to south, are formed of an igneous complex of ancient granites, schists and the like, over which are largely spread vast sheets of lavas poured out by volcanoes only recently extinct and still forming one of the most distinguishing features of the landscape. The rest of the island, forming a broad strip along the north-western and western seaboard, is almost all of sedimentary origin, and the various strata, ranging in age from Permian to Tertiary, run roughly parallel to one another and to the coast-line. The innermost formation—that next to the igneous complex—is the oldest, and younger rocks crop out in order as the sea is approached.

The Quaternary or Recent deposits containing remains of *Æpyornis* and the giant lemurs lie indiscriminately over the strata, no matter what the age.

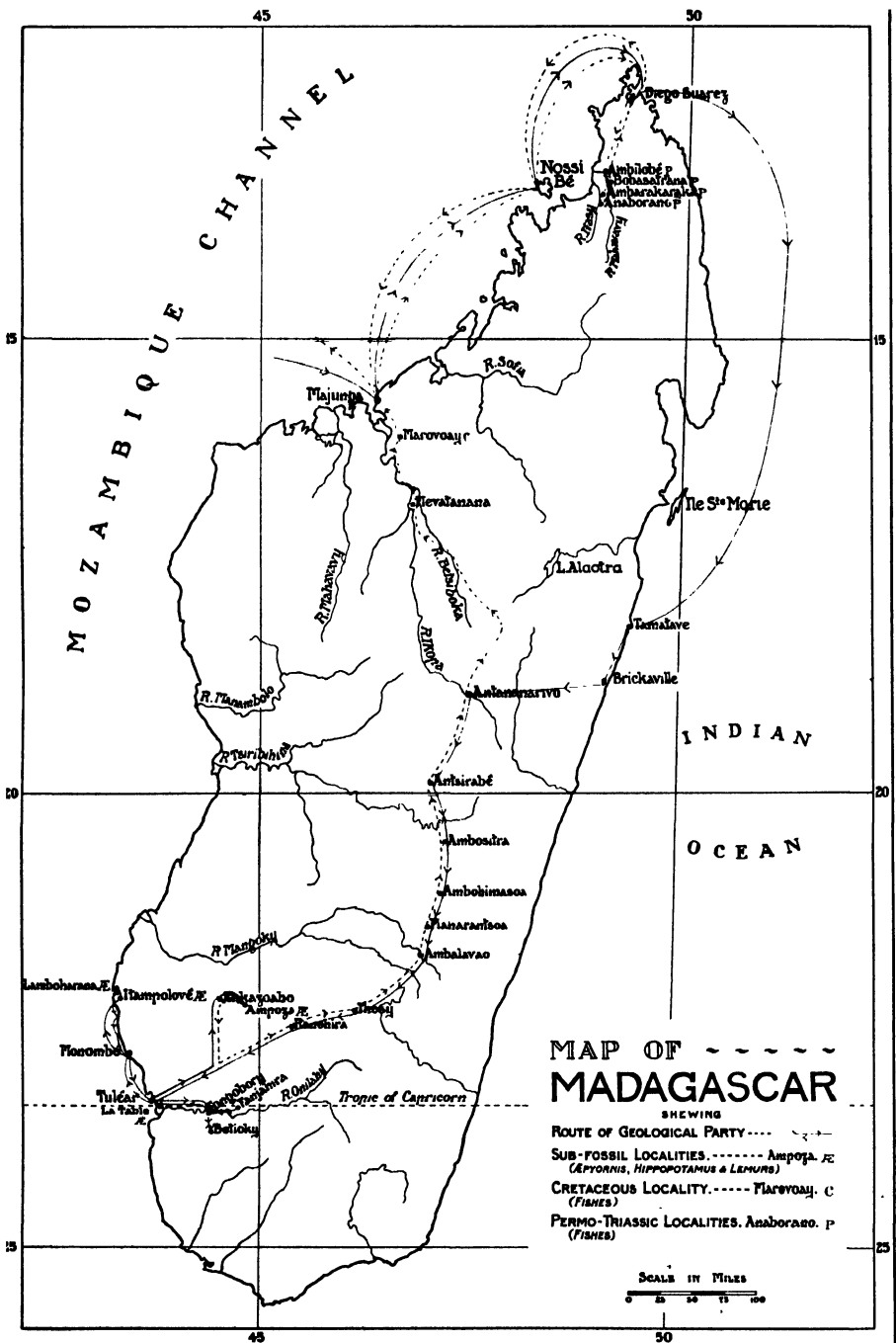
An interesting problem arises from the study of the geology and biology of Madagascar. To enable the Lemuroids and other animals to reach the island it must have been connected

to the African mainland during the earlier part of the Tertiary epoch, and the problem is when was the connexion broken. The absence of the big-game animals is clear evidence of its isolation before that fauna entered the south-east region of the continent, and this view is supported by the survival of such feeble types of lemurs and the great unwieldy birds which must have inevitably fallen prey to the swarm of active carnivores that now infest the mainland. Yet we find that two members of the big-game fauna did succeed later on in establishing themselves in the island, the pigmy hippopotamus and a river-hog, *Potamachærus*; from this fact we may deduce that the severance was not complete until some later date, and that for some time a marshy area, or perhaps a mangrove swamp, lay between Madagascar and Africa, allowing the water-loving animals to cross but effectively barring the immigration of the heavy-bodied ungulates and the great cats.

The origin of the Malagasy, too, is still shrouded in mystery, for although they are not now a pure race and are divided into many tribes with as many different characteristics, they are primarily not African, and do not speak an African tongue. The most advanced of the tribes, the so-called Hova, who inhabit Imérina, the central highlands, are a relatively light-skinned race, though with a large range in colour of complexion according to the various castes; men of the highest caste are merely swarthy, or of a yellowish tinge, often with perfectly straight black hair, while some of the womenfolk are little darker than Italians or southern Frenchwomen. Next in order of intelligence perhaps come the Betsiléô, occupying the south-eastern highlands, who are of a darker, somewhat reddish hue; but the people of other tribes, the Bâra, Mahafàly and Tanòsy of the south-west, the Vèzo of the coast to the north of Tuléar, and the Sakalàva of the north-west coast are all black with wavy hair, in part doubtless due to an admixture of negroid blood from intermarriage with imported African slaves, or perhaps with the long-vanished aboriginal inhabitants, of whom little or no trace is now to be found. The language, although divided into many dialects, so differing from one another as to make intercourse difficult between certain of the tribes, is fundamentally identical throughout the island and apparently of Malayo-Melanesian stock, and this, together with the characters previously noted, indicates the East Indies as the probable source of origin. How they managed to traverse the wide spaces of the Indian Ocean in sufficient numbers to establish themselves so firmly is still a matter of speculation, for they are certainly not now adven-

turous sailors, and their craft, consisting of small outrigger canoes and small coastal schooners of foreign design, are certainly not suitable for long voyages.

For some years an expedition to this interesting island had been contemplated by Mr. Percy R. Lowe, Assistant Keeper in charge of the Bird Room of the British Museum (Natural History), but it was not until last year (1929) that funds were forthcoming and arrangements were made with the French authorities. Thanks to the generosity of Mr. Arthur Vernay, the well-known explorer and naturalist, sufficient money was available for the preparation of a small Anglo-French expedition, principally with the object of making a representative collection of the living and extinct birds. At the last moment the expedition was joined by a party of American scientists, whose expenses were defrayed by the late Mr. Archbold of New York, and thus it assumed an international character. The vanguard of the expedition, consisting of five zoologists—Monsieur J. Delacour of Paris, the leader, Mr. Willoughby P. Lowe, the well-known collector of birds, two Americans, Mr. R. Archbold and Mr. Greenway, and a Canadian, Mr. Rand—left Europe towards the end of March 1929; I followed a month later, together with Mr. C. S. Webb, who was to collect live specimens for the London Zoological Gardens. On my arrival at Antananarivo, the capital, on the 26th May, I was met by Monsieur Delacour, Mr. Lowe and Mr. Greenway. They and Mr. Webb left two days later, one party going towards the North-east and the other to the South. As the scientific authorities in Madagascar refused to allow the expedition to make excavations in the central highlands, where the most fossiliferous localities are to be found, I was compelled to make my plans afresh. A delay of some few days was thereby necessitated while transport was hired, servants engaged, and provisions were purchased for the journey of 600 miles to the south-west coast, the only other region that was likely to yield the remains of the great birds for which I was to search. Consequently I had the opportunity of seeing something of the capital. Antananarivo stands apart from the rest of Madagascar. For many years before the French conquest of 1895 it was the headquarters of the dominant native tribe, the Hova, and is now the largest town in the island, having some 60,000 inhabitants. It occupies a remarkably fine situation, being placed high on a considerable hill, some two miles in length, from which it spreads on to the surrounding plain. On the highest point stands the Queen's palace, now the Museum, and from here a magnificent view may be obtained over the town



and the surrounding country. In keeping with the general absence of indigenous arts and crafts among the Hova, who are adepts at copying and have readily absorbed European culture, the buildings in Antananarivo possess few distinctive characters. The larger houses, mixed indiscriminately with those of the white inhabitants, are entirely European in design, and are characterized only by the absence of chimneys, and those of the poorer natives on the outskirts of the town are but oblong boxes of deep red unbaked brick. Since the French occupation many large new buildings have been erected, and the centre of the town, with its wide streets, fine shops, railway station, and public gardens, has an aspect altogether European.

During my stay in Antananarivo, I received much kindness and help from the English-speaking residents, especially from the British Consul (Mr. Helm Smith), the American Consul (Mr. Richardson), and the missionaries (Mr. and Mrs. G. C. Upton, of the Friends Foreign Missionary Society, and Mr. Radley, of the London Missionary Society, one of the oldest English inhabitants in the island). To them I tender my sincere thanks.

One of the chief reasons for my delay in leaving the capital was the difficulty of obtaining transport. The journey of 600 miles was not to be lightly undertaken by either the French or the native lorry-owners. None knew the route, which had only been recently completed, and stories of the difficulties to be encountered on the road were plentiful, although all proved later to be unfounded. During the rainy season the roads were closed, for the bridges that spanned the numerous rivers were merely temporary structures and so insecure in their appearance as to give rise to no little apprehension for one's safety as the heavily-laden lorry bumped and clattered over the roughly-hewn logs of which they were constructed. Many are swept away by the flooded rivers and have to be renewed each spring.

Eventually I persuaded a young Bourbonnais to undertake the journey, and fixed the 5th June as the day of departure. However, more delay occurred; on the evening of the 4th the native servants, consisting of an interpreter, a cook, and a boy, all Hova of various grades, informed me that owing to the outbreak of plague in Imérina, they would have to be inoculated before the authorities would grant them permission to leave the province. It was too late to get anything done that day, and so the departure had to be postponed until the 6th.

The first part of the journey was among the bare, rounded hills of the highlands with scarcely a tree to be seen. Here and there were groups of the box-like native houses, often surrounded

by a high village wall of the same kind of reddish unbaked bricks as those composing the houses, reminders of the days of tribal warfare and raiding. In the valleys stretched the



FIG. 2.—COUNTRY BETWEEN AMBALAVAO AND IHÔSY ON THE ROAD TO TULÉAR.

water-covered rice-fields, which were empty after the harvest and showed the low mud banks that divided them. Further to the south, where the mountains became more prominent, woods added a welcome feature to the landscape. In the afternoon we

passed through Antsirabé, a well-built, modern town which enjoys a considerable reputation as a "spa" by reason of its mineral springs. We had now entered the healthiest part of the island, where the climate is said to resemble that of the south of France, and a mosquito-net is not required at night, although everywhere else it is essential. It was here that I had originally hoped to make my headquarters, for it is in the heart of the *Æpyornis* country and readily accessible from the capital by means of the short railway line of which it is the terminus. With Antsirabé behind us we entered the Bétsiléô country, and here even the most casual observer cannot fail to notice the intensity of the cultivation. Every square inch of available ground is utilized for rice-growing. Not only are the valleys used, but the hillsides themselves are terraced like giant stair-cases right up to the level of the springs which are trapped and made to irrigate each terrace in turn until the fields in the valley-bottom are reached. Everywhere in the rice-fields were numbers of handsome white cattle-egrets, either wheeling about in large flocks or carefully picking their way through the shallow water in search of tit-bits.

Leaving Ambôsitra, where we spent the night, we passed through mountainous scenery all the second day, but beyond Ambalavao the country began to open out. On the third day we passed through Ihôsy, the last of the towns on the road, and into the savannah country which continued for another 150

miles, and on the fourth day we entered the forest belt to the north-east of Tuléar. It was here that we encountered lemurs for the first time, a troop of the ring-tailed "maki" (*Lemur catta*) crossing the road with graceful bounds in front of our lorry.

At 4.30 we reached Tuléar, which was very different from what we had expected, being quite a considerable but rather rambling town with large brick buildings glistening white in the bright sunlight, capped, as usual, with corrugated iron roofs. Its somewhat dowdy aspect and lack of public works gave the impression of being forgotten by the more fortunate folk up in the capital. As I found soon afterwards, the water supply, though a thorny subject much debated, did not exist, there was no electric supply or gas in the place, and the sanitation was primitive, to put it as politely as possible. However, there were two "hotels," each having about four rooms, and I chose the "Grand," the appearance of which was not quite equal to its name, being one-storeyed and somewhat like a glorified cow-shed. The port does not appear to be very flourishing. As at Tamatave, the "harbour" is a roadstead inside the ever-present coral reef, which here is almost a mile and a half from the shore. Unfortunately little attention has been paid to the dredging of the harbour, and a hapless experiment in controlling the mouth of the neighbouring river Fiherenana has resulted in a vast accumulation of mud in the roadstead. The visiting cargo-boats, which average only about one or two a month even in the busy season, have now to anchor nearly a mile from the shore.

From Tuléar I decided to proceed to a spot called Itàmpolové, sixty miles up the coast. This region had not been explored for fossils for many years, but I had

read before leaving England an account in which it was stated that both *Æpyornis* and *Mullerornis* were to be found there, especially around the margins of the small lakes which occur



FIG. 3.—IN THE BÉTSILÉO COUNTRY.
Showing the method of terracing the hill-sides to form
rice-fields.

here and there in the limestone that forms a superficial layer in that region. The account added that there was a possibility of finding complete skeletons of these birds, but that the author



FIG. 4.—IN THE FOREST BELT NEAR TULÉAR.

then visited the French Administrator, Monsieur Gitot, who received me most kindly, and promised me that, as there was no administrator or even a white man within forty miles of that locality, he would telegraph to the nearest officials at Morombé, forty miles to the north, to give orders to the native chiefs to meet me at Itàmpolové with the labourers necessary for the work.

An unexpected difficulty was encountered in the hire of a boat. As ill-luck would have it a Norwegian cargo-boat was in the roadstead, and all the native craft were employed in loading and unloading. While such easy and remunerative work was to be had there seemed to be no chance of persuading the natives to leave it for the possibly more difficult and precarious trip up the coast. Fortunately I had had an introduction to a Mr. Vacha, a prominent local merchant and a British subject, and to him I owe a debt of gratitude not only for his ready help on this and all other occasions, but for his kindness and hospitality during my forced stay at Tuléar. After a delay of a few days Mr. Vacha succeeded in engaging a native schooner for the journey, and our departure was fixed for the 14th. A ten-ton Malagasy schooner is not one of the jolliest forms of transport that I know. The "cabin" was only two feet high and very little longer or broader than myself, so, as the hold with its myriad of $2\frac{1}{2}$ -inch cockroaches, *et cetera*, was out of the question, I spent the voyage on the few square feet of deck that were not encumbered with baggage and cargo. However, with a good

had had to abandon the area owing to the cupidity of the native chiefs! This, of course, was in the old days of the native government. Apparently there was no means of getting to this region except by native schooners, which took two days to do the journey. I

following breeze, we made fair progress along the coast—sandy and scrub-covered, without sign of life—and two days later we entered Assassins' Bay, on the shores of which Itàmpolové is situated. We dropped anchor a quarter of a mile from the shore, which presented a little more inviting appearance than the rest of the coast. A long strip of fine white sand was backed by shady trees, among which were the grass huts of the village, long since deserted. Canoes quickly put off from the shore, and by these the expedition was soon on land and there greeted by the local chieftain and the workers promised by Monsieur Gitot.

I decided to use my tent in spite of its meagre proportions— $7\frac{1}{2}$ feet square—and the erection of this was a source of great wonder and entertainment, for the Malagasy are among the best spectators in the world, and are seldom so unwise as to intrude upon other folks' business by an offer of help.

The first drawback of this place was soon apparent. No supplies could be got locally, and all food would have to be fetched in the canoe, necessitating a journey of two days. Fortunately I had sufficient rice for the men for a little while, but my supply was naturally limited, and at the rate of 65 lb. of rice a day (each man had $2\frac{1}{2}$ lb. a day) it would soon be exhausted.

The first thing to be settled was the question of wages, and these were fixed at the rate of 21 francs (3s. 6d.) a week per man. The question of money was always a trouble. It has to be in coins of 50 centimes or 1 or 2 francs, or else in 5-franc notes. A month's supply for twenty or more men meant quite an item in the luggage.

Even more serious than the difficulty of obtaining food was the shortage of fresh water. This was only obtainable from small lakes which lay at some distance from the village, and around which I intended to excavate. All the water, of course, had to be boiled and filtered, and well that it



FIG. 5.—ITÀMPOLOVÉ.

The desert-scrub consists chiefly of spiny Euphorbias.

was so, for I found after I had left this neighbourhood that the lakes were also the washing-pools of my workers!

The following day was taken up with preparations, and



FIG. 6.—ITÂMPOLOVÉ. VIEW OF ONE OF THE SMALL LAKES WITH BOTTLE-BAOBABS BEYOND.

then prospecting started. I soon discovered that I should have brought dynamite, for the two-foot layer of hard travertine covered the ground in almost every direction, presenting at times an insuperable obstacle (see Fig. 6). However, after some search I found a spot near one of

the lakes where the cover was thinner than usual and this could be removed with crowbars.

The method of working was simple enough; a long trench was dug parallel to the lake and material was thrown out on the side nearer the water's edge and used as a dam to prevent the water entering the trench, which was then widened by pushing the dam farther and farther into the lake, for it was in that direction that we expected to make the best finds. However, the first excavation yielded only a few bones of the pigmy hippopotamus, and after a few days other trials were made at different spots, but with even less promising results. At last, however, we chanced upon a small pond, almost completely dried up, which had been fenced round and used as a rice-field, the only one I saw in that region. A trial trench was dug and several well-preserved hippopotamus bones were discovered at no great depth in the black mud. This looked hopeful, so we started in earnest, but it soon became evident that water, ironically enough, was going to be the chief source of hindrance. No sooner had we dug a foot or two down than the hole was filled, and getting rid of it by means of hand-bailing was difficult, for, as we were in a basin, it quickly re-collected in the trench, which now ran right across the pond. For the time being pits were dug on either side and the water thrown therein. As the trench was widened the earth was thrown into the middle and the excavation became circular and divided into four sec-

tions, two of which were used as reservoirs while the other two were worked. The progress of the digging was very slow. The natives are not used to labour of this nature; normally they use only the "angàdy"—a narrow-bladed spade a foot long, with a long straight handle which allows small purchase and is not suitable for more than shifting loose surface soil. Moreover, the men are not used to heavy labour; indeed, they never do any unless compelled. After the first two or three feet had been removed a loose whitish chalky layer about six inches or a foot thick was encountered, and beneath that black earth again. It was in the last that we found our first fragments of the great birds for which we were searching. Later I found that this white band was present wherever we worked, no matter what locality, and it was underneath it that the best preserved remains of *Aepyornis* and the great lemurs occurred. Often, especially in the inland areas, it was hardened into a very tough limestone rock, and it then proved a formidable obstacle. Now that we had found the right level more careful work was necessary, and the spades were put aside in favour of blunt spears with a short 18-inch handle, with which clods of earth could be loosened one by one, examined, and thrown behind the native who squatted in the trench on a rock with his legs in about two feet of liquid mud. Every morning two, or even three, hours had to be devoted to bailing out the water accumulated overnight, and only then the real work was begun. Thus for three weeks work proceeded; the rice-field was now nearly finished and new areas had to be found.

News was brought to me that at Lambohàrana, on the other side of the bay, similar deposits were to be found, and so I sent my Hova interpreter, Ramamònjy, to test them while I continued at Itàm-



FIG. 7.—ONE OF THE EXCAVATIONS AT ITÀMPOLOVÉ.

polové. Ramamònjy I found to be a most intelligent and enterprising assistant. Aged about sixty-five, but exceedingly active, for the Hova do not age more quickly than Europeans,

he had been a preparator at the Museum of the Malagasy Academy at Antananarivo, and was with Dr. H. F. Standing when he made his memorable discoveries in similar deposits in the central uplands. Ramamònjy was therefore perfectly familiar with the working of these excavations and his advice was invaluable.



FIG. 8.—NATIVE PRISONERS HAULING THE LORRY ACROSS THE RIVER FIHERENANA AT LAMBROMAKÁNDRA.

On receiving a favourable report, backed by good specimens, I decided to leave Ramamònjy with sufficient money and supplies to

work for another month at Lambohàrana and to go myself to other localities in the interior of which I had heard. This meant taking a risk, but something had to be done to speed up the work of the expedition. We had been in Madagascar since May and not a great deal had been found; moreover, time was limited. By dividing the expedition I had hoped to double the output. Accordingly, having arranged to meet Ramamònjy at Tuléar on the 1st August, I hired native canoes and embarked for the south.

The first day's journey was agreeable enough, paddling along the lagoons inside the reef and watching the gloriously tinted corals and vividly coloured fish which there abounded, but it was soon evident that the wind which was blowing ahead would prolong the journey considerably. Only occasionally could we use the sails, and by evening not more than fifteen miles had been made. We put ashore at a native village, Saolàra, on the way, but I was surprised to find it deserted except for a few old folk. Asking why, I was told that all the able-bodied men took flight at the sight of a white man, as white men and work were, in the natives' experience, too intimately associated to make it worth their while to stay to say "Howdy."

Next morning we pushed off, and the sight of the sunrise, one of the most glorious I have ever seen, was ample reward for the discomforts of a cramped seat on a tin trunk in a native canoe. The wind was still too light to be of service, and we

could only make headway by punting; progress was in consequence tediously slow. As the day wore on, the wind shifted adversely, and we began further to feel the effects of the tide, which at the ebb left us scarcely enough water on the landward side of the reef for even the canoes, and here in places the reef spread almost as far as the shore and we had to pick our way through the channels. Every now and again we ran aground on some especially prominent part of the reef, and the natives had to jump out and half lift the laden canoes off into deep water. These interruptions often provided the men with the opportunity for a little surreptitious fishing, but the beauty and grotesqueness of their captures amply repaid the slight delay occasioned. The most striking were undoubtedly the large Parrot-wrasses (*Pseudoscarus*), whose coloration was almost unbelievable; the large scales were sky-blue edged with yellow, except on the stomach, where they were pink, while the head was bright blue with scarlet lines radiating from the eye, and the fins blue edged with red. One other catch worth mentioning was the cuttle-fish, never very large here. The natives in fishing use a spear armed with three wire prongs set in a triangle, and after the cuttle-fish had been sufficiently pronged it was turned inside out to remove the cuttle-bone (and not always before the animal had ceased moving) and then secured to the arms of the outrigger, to be subsequently toasted on a hot stone and eaten almost raw, the arms being pulled off and eaten like sugar-sticks.

About 8.30 in the evening we crawled painfully into Faramasà, where I saw for the first and only time the preparation of trepang, or bêche-de-mer. Several varieties of sea-cucumbers abound along the reef and form the basis of a considerable in-



FIG. 9.—THE AMPÒZA STREAM.

dustry. They are collected in large numbers and, after being carefully boiled in an enormous open-air cauldron, are buried for a short time, then split, sun-dried, and finally packed off to China.

Next morning the wind was light, as usual before noon, but later it changed to the south, and with this change the sea became choppy and on several occasions we narrowly missed



FIG. 10.—THE CHIEF EXCAVATION NEAR AMPÒZA.

Note the pile of Hippopotamus bones in the foreground.

being swamped. Finally, the crews refused to proceed further than the next fishing village, but to get there we had to round a small headland opposite a gap in the reef through which the breakers were rolling with considerable force. We made a dash for it, but sure enough one by one the canoes piled

up on the submerged part of the headland opposite the opening, and we had a few quite exciting moments, for the waves were crashing into our craft broadside on. After a great deal of splashing and shouting we were at last pulled off and made a hurried rather than dignified bee-line for the shore, where the damage, amounting to nothing more than a wetting all round, was soon repaired. Later, as the wind softened, we decided to push on to Monòmbò, which is an important native centre, even boasting of a road to Tuléar, and there we arrived without further incident, and camped for the night. At three o'clock next morning we were up. We pushed off, and skirting the mangrove swamps which here form a considerable promontory, reached the main channel, where with sails spread we made steady way under the early morning breeze. One phenomenon impressed itself deeply on my mind at the time—the morning star, blazing high in the southern heavens, was brilliant enough to throw a faint radiance over the whole landscape and to cause intervening objects to cast definite shadows.

All went well until we were within a few miles north of Tuléar. Here the reef runs right into the shore, and with the ebbing of the tide progress became increasingly difficult until finally all four canoes were jammed on the reef. There was nothing to do but to make the best of a bad job and wait until the tide should push us off again. Our hopes of reaching Tuléar that night

vanished, and finally we managed to reach as far as Balitzicka, a few miles to the north. The sea by this time was really rough, and it was only with difficulty that the baggage could be landed on the deeply shelving beach without getting it drenched. The wind was in the south and seemed likely to stay there, so rather than have further bother with the boatmen I sent to the village near by for an ox-cart, which arrived with remarkable speed in about two hours; but the driver spoilt this record performance by refusing to budge until next morning, and dis-



FIG. 11.—BÂRÀ GIRLS PLAYING THE NATIVE "PIANO," MADE OF LENGTHS OF CAMPHORWOOD.



FIG. 12.—BÂRÀ LABOURERS.
Men of this tribe frequently exceed 6 ft. in height.

appeared, leaving the team and cart on the beach, where the oxen chewed, puffed and blew until next morning, when we made a triumphant but slightly undignified entrance into Tuléar.

I had two areas in mind for my fresh venture, one round Ankazoàbo, about 160 miles to the north-east, and Betiòky to the south-east. Both were accessible by road, but the difficulty was, as usual, to obtain a vehicle. Lorries for hire are limited in number in Tuléar, there being about four in all, and nobody ever seems anxious to hire them out. Down there everyone—native, half-breed and Creole—are deeply infested by the germ of "to-morrow-will-do." To make matters worse, it was the week preceding the 14th July, the French national holiday.

I decided to visit the south-east area first, but it soon became evident that my chances of getting away from Tuléar before

the celebrations took place were few and (as I found out afterwards) until they had duly recovered from the celebrations—in fact, I had to wait eight days—but it was almost worth while



FIG. 13.—ON THE MAJUNGA ROAD.

A view of the country south of Mevatanana.

to see the natives celebrate. The whole town turned out in its Sunday best, that is, cheap or cast-off European clothes with the addition of boaters for the men, and lambas or native togas wound over their finery. There were the usual processions of children, who paraded in front of the Residence and

sang “patriotic” songs, while the youths did not waste any of the special privilege of purchasing alcohol at the hotel without time-limit. On the greensward by the quay the whole population assembled to see the native bull-fights, a most interesting spectacle. These fights, between bull and bull, are a great source of delight to the Malagasy. The population stood along the two sides of the greensward, while in between them at odd intervals were the bulls, some gaily decorated in honour of past victories, each with his owner holding on tightly. Some of these creatures were of most imposing dimensions; a white one particularly took my eye. His horns were cut short and sharpened as is the custom, and his body not a whit smaller than that of a prize English bull, but enhanced by the huge hump over the shoulder and the wide dewlap under his chin and neck. Two bulls, considered to be fairly matched, were introduced to each other and the fight started (or should have started). As a matter of fact, most of them did not seem to have much stomach for the duel in spite of the presence of their consorts near by to encourage them. In every encounter I saw one bull got “cold feet” before any damage was done and fled from the field, scattering the many-hued spectators before him. Nevertheless, one or two are usually killed, and I saw one of the losers with a hole in his side led in triumph round the town by his conqueror’s owner (whose property he becomes), to die an hour or two later.

So the day wore on, and with the evening came dancing and merrymaking, which went on until three o'clock in the morning, when those that could walk went home carrying their less fortunate friends with them.

The next day was also a gala day, and even on the day following a few celebrations were taking place.

Finally, after much persuasion, I succeeded in getting a native to take me in his lorry to Tongobòry and Betiòky in the south-east. The roads were not very good but the scenery was fine, especially along the banks of the Onilàhy, the largest river of the south-west. Twice where the road crossed an old river bed we stuck in the sands and it needed much energy to get us free. Betiòky struck me as being the least interesting town I had seen. Its white population consists of four persons, the Administrator and his subordinate, a missionary and the keeper of alcoholic refreshments, who is to be found in all villages of any size. There is a law which prohibits the sale of less than two litres of alcoholic liquor to a native, but I doubt if it be strictly enforced. I obtained little information of value except that the location I had heard of had been very well worked years before, so I did not think it worth while to stay there. From Betiòky I returned north once again as far as Tongobòry, and then travelled eastwards for 25 miles to an American-Norwegian Mission Station at Fanjahira, where a Dr. Dyrnes was said to be well acquainted with the fossil localities. The road was good for only half the distance, the rest of the journey having to be made in a *filanjana*, the native palanquin, consisting of a chair with a foot-rest slung between two poles carried by relays of natives. This was my first acquaintance with this method of travelling, and it proved



FIG. 14.—CROSSING THE BETSIBOKA RIVER ON THE WAY TO MAROVOÏY.

more agreeable than I had expected; with good bearers who keep in step the rhythmic motion is not unpleasant, rather like that of a rowing boat in a mild sea. The most disagreeable

feature is the constant exposure to the sun, especially when on the back, for there is no protection. This journey proved as fruitless as that to Betiöky, so I returned at once to Tuléar, where I heard of a new locality about ten miles south of Tuléar itself.



FIG. 15.—NATIVE CARRIERS CROSSING THE MAHAVAVY RIVER AT BOBASATRANA.

The new locality was on the verge of the forest at La Table in the Mahafaly country. I paid a visit there and found remains of *Æpyornis*, and then returned for the outfit. Work here was at first most successful.

We enlarged an old well and quickly found the best part of the foot of an *Æpyornis*, a few vertebræ—one of enormous size—and some ribs, and then when I had visions of an *Æpyornis* complete the bed petered out, and although we worked for several days longer, nothing more was found than a couple of hippopotamus bones. There was nothing to do but to return to Tuléar, especially as I was due to meet Ramamônjy from Lambohàrana in a day or two. I waited there a few days, but the monsoon from the south had set in with the new moon and was likely to blow hard for some time, so I determined to move to the Ankazoàbo area and leave instructions for him to follow on. By this time I was familiar with all the owners of vehicles in Tuléar and was able to find a lorry easily, although the price—6 francs a km. (1s. 7d. a mile) was hair-raising, and this for 250 km. ! We set off once more along the Antananarivo Road through the forest and up north by Lambromakàndra, where the road runs through the river, literally, for there is no bridge, and the track across the river consists of bundles of grass in the shallows and, of course, nothing at all in the channels, where the water is axle-deep, even in dry weather (nothing can cross in the wet, of course). Gangs of native prisoners, chiefly cattle-thieves, are kept on the banks to pull and push cars through the water (see Fig. 8). The work is not very arduous—only one or two vehicles pass per day, and there is free food for self, wives, and family, with nothing else to do; it is the sort of life that rather appeals to the native.

The country which we now entered may be termed upland savannah, for we had been ascending for some time on to rolling grassy plains dotted with isolated trees, chiefly the Sakoa, and on either side in the distance appeared ranges of considerable mountains, while here and there nearer at hand were curious isolated little table-mountains and occasionally a belt of forest. Late in the evening we began to descend into the lower country, and after one more pull through the river, this time in the pitch darkness, we reached Ankazoàbo, arriving at about seven o'clock. Little could be seen of the town in the dark, but we found a spacious and clean rest-house with three rooms.

Next morning I had time to look round before visiting the Administrator. Ankazoàbo is the capital of the province to which it gives its name. It is situated on the edge of a forest on a slight eminence capped by the Residence and other buildings of the Administration, and is flanked on the west side by the Sakanavaka, a large but shallow river. The majority of the dwellings are native huts, either of red brick or grass, but there are besides numerous two-storied buildings, inhabited by the Indian traders, and one very large French store. The town is well planned with wide avenues flanked by numerous trees, among which the imported Cape Lilac predominates. The inhabitants are mostly Bétсилéо, and form an isolated colony, the people of the surrounding country being the Barà, a black race of negroid aspect (see Fig. 12).

Early on the following morning I was joined by two Catholic priests who had shared my lorry from Tuléar, and we paid a visit to M. Ravel, the genial Chief of the Province, who promised to do all he could to help me by providing labour, transport, and even the tools necessary for



FIG. 16.—PORTERS PREPARING BAGGAGE AT BOBASATRANA.

excavating. Equally welcome was the information I received about possible localities, and one, near Ampòza, a small village 17 miles to the east, was indicated as the most likely to yield

good results. I heard that the Malagasy Academy had worked in this area for three seasons some time ago, but had abandoned it, for the time being at any rate, so I hoped there might be



FIG. 17.—AMBARAKARAKA.

The huts are thatched with leaves of the Traveller's Tree (*Ravenala*), and the sides built of the midribs. In the background are seen Mango trees (L. and R.), a Coconut palm and Cotton-seed trees (R.C.).

others near by as yet untouched, and made plans accordingly. The journey to Ampôza was made in a filanjana, with 25 Barà carriers for the baggage. The country was pretty, although not striking, and consisted of rolling downs studded with Sakoa trees and occasional valleys. Everywhere one saw numbers

of the Vasa parrot, either flying singly or in large flocks. They are large, uninteresting-looking birds, of a uniform dark grey colour, and much disliked by the natives on account of their depredations in the rice-fields. A smaller and even duller-coloured parrot haunts the forest areas, but the smallest of all, the little Malagasy love-bird, is like a living gem, with its brilliant emerald body and light grey head. Hawks too were common, especially that cosmopolitan robber of chicken-runs, the Egyptian kite. Loathed though he is by everyone, he shares with the even commoner pied crow the useful function of "garbage-remover," though doubtless natives consider the removal of garbage of small importance compared with the equally frequent removal of poultry.

Here too in the neighbouring forests are several species of lemurs, and during my stay at Ampôza many were brought to me by the villagers, who, looking upon everything moving merely as potential food, regarded my habit of keeping pets as a mild and harmless form of lunacy. The handsomest of these creatures was the white black-capped lemur, or Sifaka (*Propithecus verreauxi*), of which I had several, one accompanying me as far as the capital, where a broken collar ended our acquaintance.

The village consisted of about 30 grass huts, each about

14 feet long and 8 feet wide, with grass roofs, and two of brick, of which the larger one was the rest-house, where I quickly installed myself. It proved comfortable enough except that, having no ceiling, any wind brought down a continuous stream of entomological specimens of divers shapes and sizes, among which predominated huge brown and yellow cockroaches.

On the following morning when I paraded the men for work they told me that they considered they had been engaged solely for the journey and that they were now free, and all but seven refused point-blank to work and marched off back to Ankazoàbo. The only thing to do was to send to the Administrator and in the meantime make trial diggings with what labour I had left.

The first locality was in the valley of a small stream about a mile away. Here a trial pit had already been dug, and fortunately the overburden, consisting of about 8 feet of black earth, had been removed from a considerable area. However, there was then an 18-inch layer of limestone to be cleared away over most of it, and this presented much difficulty at times. Underneath this limestone were the fossiliferous layers consisting of two or three feet of black mud and finally barren light-coloured sands, sometimes coloured bright blue and green. Selecting a spot in a bend of the stream, we soon unearthed a large quantity of bones, mostly hippopotamus, but also a few of *Æpyornis*, *Mullerornis*, and the great extinct lemurs.

Two days later the rest of the workers returned, this time under an armed guard of two militia, who remained with me for the rest of my stay at Ampòza. The position of the diggings made drainage easy and the workings grew apace. After a few weeks a fair amount of good material had been



FIG. 18.—AMBARAKARAKA.

The humped "zebu" form the bulk of the natives' wealth.

discovered as well as less valuable hippo and crocodile skulls and a complete carapace of a very large extinct tortoise. In the meantime a Swede and his Norwegian wife—Mr. and Mrs.

Ljungqvist—had arrived at the village on the same errand as myself and started with half a dozen workers in a more distant locality—three miles to the north. Although fairly successful,



FIG. 19.—THE RIVER IFASY AT ANABORANO.

they left after a short time, and so, my own locality being exhausted, I transferred to their diggings, and by enlarging the excavations began to get excellent results, especially of the lemur material. Ramamônjy, the interpreter, had rejoined me during the first week, bringing with him

much hippo material and a fair quantity of *Aepyornis* and lemur bones. The working of the new excavation was more difficult than the first—in the middle was a spring of clean, fresh water which ran down to the Ampôza river 30 yards away, and this had to be banked and drained away. In spite of precautions the workings were flooded each morning and had to be baled out for a couple of hours before work could be resumed.

Work went on steadily until the beginning of September. The pit now became difficult to work. It was about 40 yards long and 20 yards wide (see Fig. 10), and as the ground was rising the overburden was becoming unmanageable, 12 or more feet in places. Any shovelling was slow work with the native spades, and the men never took a good spadeful at a time unless I was standing over them; moreover, they quickly tired, requiring a rest of about one minute in every four.

Time was now short, and I decided to send for transport and make my way home. After two days I learned that the only available lorry had been commandeered by the Administrator, and this meant a delay for a week, for which I was ever after grateful: for, work being restarted in earnest, more good things were found during that week's wait than during the whole of my previous four months' work!

However, I could stay no longer, as I had to go to the other end of the island after the fossil fishes which were said to be

plentiful in the Permian and Triassic beds, both in the north-west and north-east.

Eventually I arrived at Tuléar on the 15th September, there meeting Messrs. Rand and Archbold, of the zoological party, who were collecting the birds in that area. As it was quite impossible to take my two lorry-loads of fossils across the island, I was glad to take advantage of Mr. Vacha's kind offer to put the packing-cases on board a cargo-boat then in the port, and so left for Antananarivo with Archbold, whose company was most welcome, especially after the long months on my own. A few days were spent in the capital visiting officials and making purchases, and again I received much kindness from the missionaries, Mr. and Mrs. Upton, and Mr. Conolly.

Marovoay was our next objective and was reached in two days by lorry. A week was spent here, but with little result—some Cretaceous fish teeth being the only finds.

One last area remained to be visited, and this lay in the north-east of the island, about 100 miles south of Diego Suarez. The first step was to the nearest port, Majunga, where I found the only way to Diego was by the European liners which called on their way round to Tamatave. Bidding Archbold farewell, I boarded the "Explorateur Grandidier" and arrived at Diego on the 19th October. Thanks to the ready help and precise information of Monsieur Laporte, Chief of the Region, himself an amateur geologist, I was able to leave first thing next morning in a lorry, and arrived at Ambilobé, 70 miles to the south, the same day. Around here are numerous localities yielding fossil fishes which occur as impressions inside hollow sandstone nodules. Nothing can be seen from the outside, but when cracked and split a complete imprint of the fish is seen on both sides, and from these moulds remarkably delicate casts can be made of the fish, and even the finest details of the



FIG. 20.—AMBARAKARAKA.

The hill-side where most of the "fish-nodules" were found.

bones of the head have been obtained. These fossils are found on small hillsides (see Fig. 20), where they are washed out of the sandy shales by the torrential rains.



FIG. 21.—“TRANSPORT COLUMN” IN DIFFICULTIES ON THE WAY BACK TO AMBILOBÉ.

The rains occur usually during the summer months—November to March—and were now overdue, and this caused some anxiety, as several rivers had to be crossed. Now they were only a few inches deep, but one or two storms, the usual prelude to the rainy season, would raise the

level so as to make them impassable, and this might mean spending the rest of the season in the bush. However, bearers and a filanjana were quickly obtained, and acting on the information given to me by local planters and natives, we crossed the Mahavavy River (Fig. 15) to Bobasatrana, a village about ten miles away, and such was the productiveness of this locality that I collected sufficient specimens in two hours. From here I pushed on another 50 miles to the south. The road lay through savannah and forest country, the latter being especially interesting, and I had the good fortune to see several troops of different species of lemurs, shy animals at all times. Plenty of good shooting was to be had: wild guinea-fowl and a very small yellow-green pigeon were plentiful, while ducks abounded on the small ponds and lakes. Here the most obvious bird is the Tolòho (*Centropus*), a dark-coloured bird of the size of a large blackbird, whose varied notes can be heard night and day, one resembling water pouring from a narrow-necked bottle being the most frequent. The fork-tailed drongo, the green bee-eater and the green, grey-headed love-birds too were frequent, while prominent among the larger insects were the cicadas, of which I had seen none in the south-west.

The villages here were a refreshing change to the rather bare collections of huts one sees in the South, and everywhere trees were numerous, especially the raffia and coconut palms.

After two days we reached Anaboràno, which lies in a basin surrounded by considerable mountains on three sides. Among these mountains are the highest in the island; the largest, Tsaratanàna, attains a height of 9000 or 10,000 feet. This mountain is sacred, and even now no Malagasy will venture up its slopes. It is, I believe, still unexplored. At Anaboràno I was received by an Alsatian family, named Wantz, and treated with the utmost kindness and hospitality. Thanks to my new friends, the fossil localities were soon found, some nearby in a small range of hills that studded the wide valley, and another farther afield. These proved almost as fruitful as the first and yielded a slightly different and, I think, older fauna. One locality I could not reach, as the bearers refused to cross a river on account of crocodiles, which were said to be abundant in the region. One planter told me that one hundred natives were lost yearly through these voracious beasts in the Ambilobé region !

A week's work was sufficient for my purpose and, as the rains had already started, I got off quickly so as to avoid being cut off, and started on my way home. By the 7th of December I was in Diego Suarez, and one week later boarded the "Explo-rateur Grandidier" once again, but this time for home.

It has not been possible to express adequately in this account my indebtedness to the many people who so ungrudgingly helped me at various times during my travels in Madagascar, nor can I do more than give a mere indication of the extent of that help. Nevertheless, there are some I would mention once again, and to these I tender my best thanks : the Consul, Mr. Helm Smith, Mr. and Mrs. G. C. Upton, all of Antananarivo, Mr. S. D. Vacha of Tuléar, and Mr. Rowntree, Vice-Consul at Majunga.

MARION'S TORTOISE.

By H. W. PARKER, B.A., Assistant Keeper, Department of Zoology.

DURING the last forty years much has been written of the Giant Tortoises of the islands of the Indian Ocean and the Galapagos group. The interest which they have aroused is due partly to the appeal which their large size and reputed great age make to the imagination, and partly to the pathetic story of their ruthless extermination and the consequent difficulties which beset any attempt to discover their original distribution. What is, perhaps, the most famous of them all has now, thanks

to the generosity of the Officers of the Royal Artillery, come into the possession of the Museum, and a résumé of its history may possibly be of interest to readers of this Magazine.

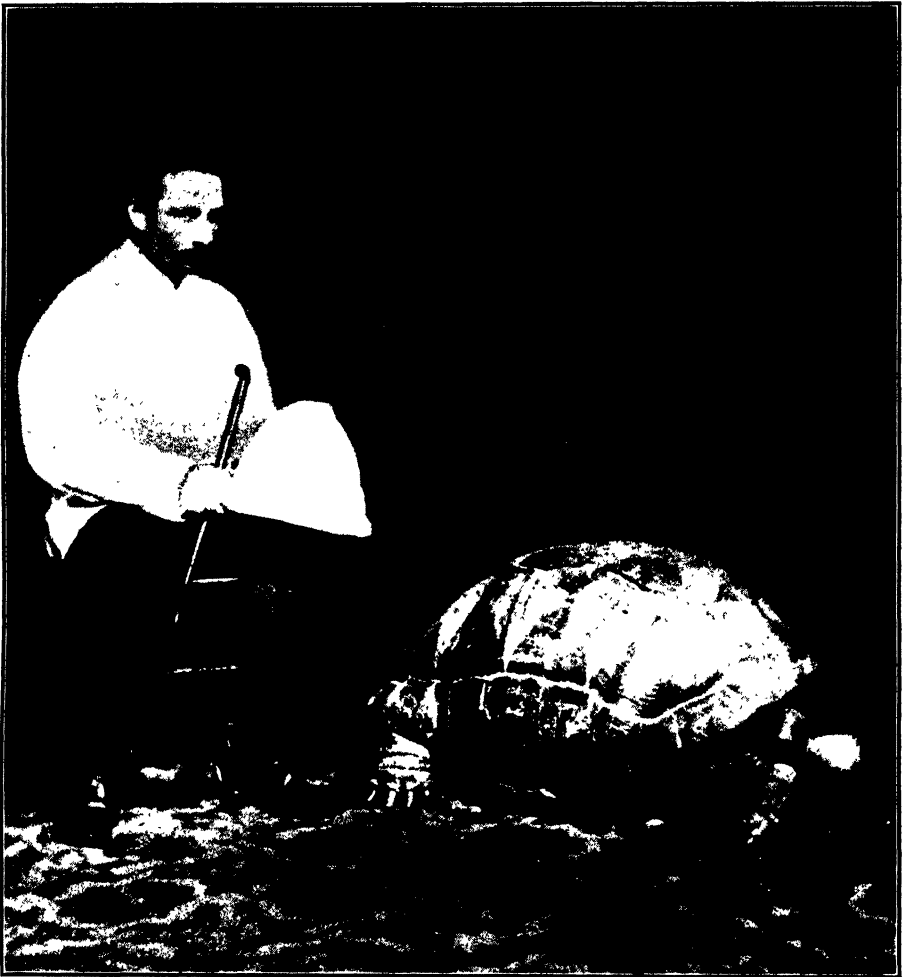


FIG. 1.—MARION'S TORTOISE IN THE YEAR 1870.

It is known that in 1766 the French explorer, the Chevalier Marion de Fresne, took with him to the island of Mauritius five tortoises which were said to be of large size; whence he obtained them, or what his object may have been, we unfortunately cannot say with certainty. He is known, however, to have visited the Seychelles and Réunion, on which Giant Tortoises were then extant, and it is reasonable to suppose that those which he took to Mauritius were derived from one or other of these

groups. From 1766 until 1810 nothing further is recorded concerning these specimens; but, when the British captured the island in the latter year, a large male tortoise was living as a



FIG. 2.—MARION'S TORTOISE: SHOWING ATTITUDE WHEN WALKING.

pet in the Artillery Barracks at Port Louis, and is reported to have been handed over officially to the invading troops. This is the specimen which has just been received by the Museum.

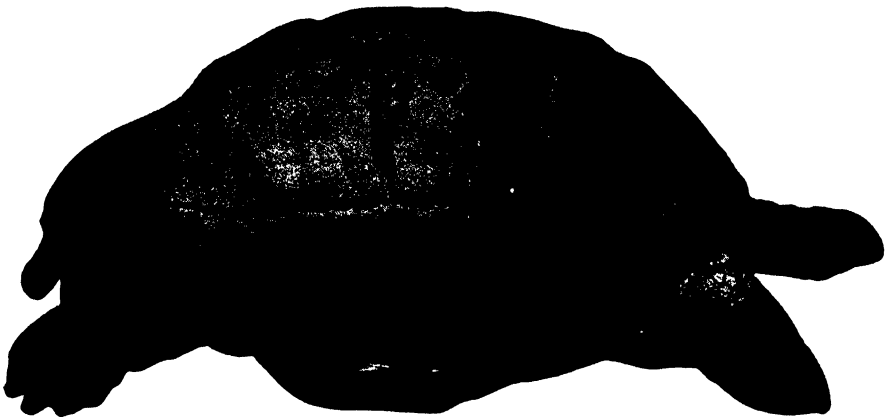


FIG. 3.—MARION'S TORTOISE: SPECIMEN MOUNTED AND PRESERVED IN THE MUSEUM.

Captain Pasfield Oliver, who had made deep researches into the early history of the Mascarene Islands, states definitely in the *Illustrated London News* of 1892 that the animal was one of those

introduced by Marion de Fresne. Its life during this period cannot have been altogether without incident, for a photograph, taken in 1870, shows the scar of a large wound, about the middle of the right side, which is still visible. The origin of this wound will probably never be discovered, but tradition ascribes it to a pistol bullet variously described as fired by a drunken French officer or by a, presumably equally drunken, subaltern of the British Army. It is remarkable that other Giant Tortoises, for instance that which lived for so many years in Colombo, have suffered in a similar manner, and it may perhaps be more reasonable, and certainly more charitable, to assume that curiosity as to the toughness of the "armour" and not drunken caprice was the motive which prompted the marksmen.

Until 1891 little or no interest was taken by scientists in the Port Louis tortoise. In that year M. Sauzier revisited the island on which he had passed his childhood and, after careful comparison with other tortoises from Aldabra and with sub-fossil specimens found on Mauritius, reached the conclusion that it represented a distinct species, which might possibly have been indigenous in Réunion. In the following year these conclusions were published and the name *Testudo sumeirei* proposed. At the same time M. Sauzier made inquiries from the older inhabitants, but, although there were still alive some who could remember the capitulation of the island in 1810, none could recall any sensible difference in its size during their lifetime; the length of the carapace was then approximately 40 inches and the weight about 300 lb. Even at the time of M. Sauzier's visit it was becoming partly blind through age, but it retained its health and regular habits until 1918, when, with its sight completely lost, it fell down a well or a gun emplacement, and was killed.

Thus, if Captain Oliver is correct in his belief that the animal is really one of those imported by Marion de Fresne, a belief which is shared by most competent judges, we have definite evidence of a tortoise living at least 152 years. What its real age may have been cannot be discovered, but the evidence shows that it was a large animal in 1766, and that growth had almost ceased even at the beginning of the nineteenth century. These considerations have led naturalists to estimate that the age could scarcely have been less than 200 years, though probably not more than 250.

None of the other four tortoises survived as long as this. One, a large male, was sent to the Zoological Society in 1833

and another a few years later. Both of these died soon after their arrival, and, as no particular importance or interest was thought at that time to be attached to them, their remains were not especially cared for and appear to have been lost. A third specimen was sent to Lord Rothschild and was recognized as being conspecific with the Port Louis specimen, and the fourth may be preserved in the Museum at Vacoas, Mauritius. It is due to the researches of Lord Rothschild, however, that we are now almost certain of the original provenance of the species. Günther, one of the earliest workers on the inter-relationships of the Giant Tortoises, had reached the conclusion that it was possible to recognize three distinct groups of races, each of these being confined to a particular group of islands: one to Aldabra and the Seychelles, another to the Galapagos Islands, and the third to the Mascarene Islands. If *Testudo sumeirei* had been really, as Sauzier supposed, a native of Réunion this grouping broke down, and previously conceived views on the relationships of the various species would have had to be considerably modified. But, as we have seen, if the tortoises were introduced by Marion de Fresne, there is nothing to indicate that they originated in Réunion rather than in the Seychelles, and their anatomical characters were found by Lord Rothschild to be in close agreement with those of tortoises definitely known to be indigenous to the latter group and to Aldabra. Consequently it seems reasonable to suppose that the Seychelles was their original home, and a corollary to this assumption is that they were some of the last representatives of a race which was almost extinct. On many islands in this group tortoises were abundant even as late as 1800, but on others, according to M. Malavois, who carried out an official inspection of the islands, they were completely exterminated before 1786, and it is highly improbable that tortoises of a common species would have been introduced into Mauritius, which had previously been the centre of a regular trade in these animals.

And so Marion's Tortoise, in addition to providing what is probably the best authenticated instance of longevity in a tortoise, must be reckoned to be not only the last survivor of his race, but also the most important of the few specimens by which mankind may know another of the creatures it has destroyed.

METEORIC IRONS FROM SOUTH-WEST AFRICA.

By L. J. SPENCER, M.A., Sc.D., F.R.S., Keeper, Department of Mineralogy.

A MASS of meteoric iron weighing 299 lb. (= 136 kilos) has recently been received as a valuable donation from the Administration of South-West Africa, through Mr. L. G. Ray, the Chief Inspector of Mines. The mass measures $26 \times 13 \times 10$ inches, and as represented in Fig. 1 it shows prominently the pitted and cavernous surface characteristic of meteoric irons.



FIG. 1.—METEORIC IRON FROM NEAR GIBEON, GREAT NAMAQUALAND.
Weight 199 lb.; dimensions 26×13 inches. Reduced to $\frac{1}{2}$.

This mass is the one that I selected in September 1929 from the pile of meteoric irons displayed in the Public Garden at Windhoek, the capital of South-West Africa, and is the one pointed to in Fig. 2. From the same lot the Honourable the Administrator of South-West Africa had already presented to the South African Museum at Cape Town a mass weighing 1431 lb., and to the Geological Survey Museum at Pretoria one of about 900 lb. Having previously seen these two fine specimens in Cape Town and Pretoria, I felt encouraged, when I arrived at Windhoek, to beg a specimen for the British Museum collection of meteorites. Whilst refraining from selecting one of the largest pieces, I selected one which showed well the characteristic surface markings.

This pile of some thirty masses with a total weight of about ten tons was lying in the open and exposed to the weather, and I recommended that better care should be taken of such a

unique display, with the result that arrangements are now being made to house the meteorites in a museum building. They had been collected from the desert in the neighbourhood of Gibeon in Great Namaqualand and brought to Windhoek. Dr. Paul Range, formerly Government Geologist of German South-West Africa, who accompanied us part of the way on the long excursion through South-West Africa organized by the International Geological Congress in 1929, informed me that the masses were



FIG. 2.—PILE OF METEORIC IRONS IN THE PUBLIC GARDEN AT WINDHOEK, SOUTH-WEST AFRICA. (Photo. Prof. W. T. Gordon.)

collected by him in 1911–12. The thirty-seven masses then collected totalled in weight 12,613 kilos (over 12 tons). At that time he accounted for fifty-one large masses with a total weight of 15,396 kilos (over 15 tons). Some of these had been previously exported to Germany, and there are large masses preserved in the museums at Hamburg (424 kilos), Frankfurt-am-Main, Bonn, Stuttgart, Berlin, Copenhagen, and Harvard University (Cambridge, Mass., U.S.A.). But in the British Museum no large complete mass of this fall has hitherto been represented, there being only fragments and slices, the largest weighing 6610 grams ($14\frac{1}{2}$ lb.).

On the railway journey from Lüderitz Bay to Windhoek, and also on the return journey from Tsumeb to Cape Town, the train made a short stop at Gibeon. There I had hasty interviews with the Station-master and the Sergeant of Police on the subject

of meteorites. They both, independently, informed me that several large masses are still lying on the Kameelhaar farm, about twelve miles east of the Gibeon railway station. The



FIG. 3.—PUBLIC GARDEN AT WINDHOEK, SOUTH-WEST AFRICA, SHOWING (ON THE RIGHT) THE PILE OF METEORITES.

Station-master, Mr. P. James, very kindly gave me for the Museum collection a specimen of the meteoric iron. This mass is a complete individual of good shape (Fig. 4), and weighing only 195 grams; it is specially interesting on account of its small size. Although complete individuals of meteoric stones of small

size—no larger than a pea—are not uncommon, complete irons of small size appear to be unusual. And possibly the latter may often be merely weathered remnants of larger masses. This little meteorite I carefully kept in my personal baggage, and on the return voyage from Cape Town it gained for me the first prize at the fancy dress ball on board. Mounted on a disk of

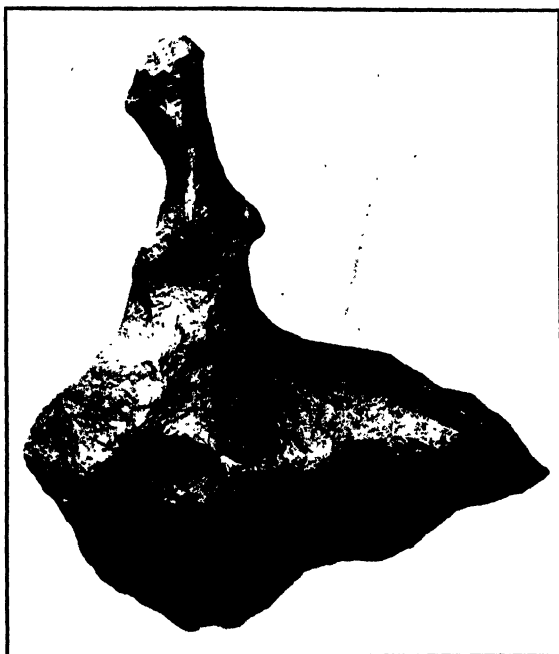


FIG. 4.—METEORIC IRON FROM NEAR GIBEON, GREAT NAMAQUALAND.
WEIGHT 195 GRAMS. ACTUAL SIZE.

card (from a chocolate box) with the inscription "The Most Noble and Celestial Order of the Fallen Star," and suspended by a red ribbon (also from a chocolate box), it made a handsome decoration.

These masses of native iron in Great Namaqualand were first heard of in 1836 by Captain (afterwards General Sir) James Edward Alexander. They were known to the natives, who hammered fragments of the malleable metal for fashioning their weapons. Alexander in 1837 reported large masses up to two feet square on the east side of the Great Fish River, at a spot three days' journey N.E. of the mission station of Bethany. He appears to have collected only chips of the iron. One of the chips was used by Sir John F. W. Herschel for a chemical analysis, and from the amount of nickel found he was able to pronounce

the iron to be of meteoric origin. Another small chip weighing 2 grams was presented by Alexander to the Geological Society of London in 1838; and this piece, which came to the British Museum in 1911, appears to be all that has been preserved of Alexander's "Great Fish River" iron. Later, other masses



FIG. 5.—THE HOBA METEORIC IRON, GROOTFONTEIN, SOUTH-WEST AFRICA.
(Photo. Prof. W. T. Gordon.)

were found between Bethany and Bersheba, on the Lion River, on the Springbok River, and near Gibeon on the farms Amalia, Goamus, and Mukerop. These names are mentioned because they are the names by which the several masses have been known; but it is probable that they all really belong to the same fall. They have been found over a tract of country extending for almost a hundred miles from Bethany in the S.S.W., across the Great Fish River,* to Gibeon in the N.N.E. Chemical analyses show the presence of about 8 per cent. of nickel alloyed with the iron, and polished and etched sections of the different masses all show much the same type of crystalline structure with prominent Widmanstätten figures.

* This is a dry river occasionally carrying flood water. When I crossed it, it was a broad and shallow sandy tract.

There must have been a terrific shower of these great masses of iron, but there is no record of the actual fall. The inhabitants, if any, at the time must have been considerably alarmed. Showers of meteoric stones (not irons) have taken place during historic times, but fortunately only very occasionally. For example, near Pultusk in Poland a hundred thousand stones, weighing from 1 gram to 9 kilos, fell at 7 p.m. on January 30, 1868; and on the desert near Holbrook in Arizona at 7.15 p.m. on July 19, 1912, there was a shower of about fourteen thousand stones, ranging in weight from a few grains to $14\frac{1}{2}$ lb. Many complete stones from each of these meteoritic showers are shown in the Museum collection. When they were pointed out to an American visitor he gravely remarked, "God is good, but he *is* careless."

Since about 1920 another far larger mass of meteoric iron has been known in Damaraland, about 400 miles north of Gibeon. This is the gigantic "Hoba" meteorite, which still reposes on Hoba West farm, 12 miles west of Grootfontein at the end of the railway in South-West Africa. This mass (Fig. 5) I was able to visit in September of last year, and I much regretted that I was quite unable to collect it for the British Museum. It has the form of a roughly rectangular block with its large upper surface level with the surrounding ground. When first found only a small portion was exposed, and a pit has now been dug partly round the mass. It is embedded in surface limestone (Kalahari Kalk), and is surrounded by a layer one foot in thickness of laminated "iron shale," which has obviously been formed by the weathering of the iron. A dozen people can walk round on the level surface of the meteorite. Measurements taken by me are 295×284 cm. (about 10×9 feet) on the large flat surface, with a thickness at one end of 111–122 cm. and at the other end of 55–75 cm. From these measurements I calculated the weight of the mass to be about 60 metric tons (of 2204 lb.). Other estimates of the weight of the mass range from 50 to 70 tons.

Only a preliminary examination has yet been made of the composition and structure of the Hoba meteoric iron. A chemical analysis gave 17.42 per cent. of nickel, and a polished and etched section showed traces of crystalline structure without Widmanstätten figures. This iron therefore probably belongs to the group of "nickel-rich ataxites," whereas the Bethany (Gibeon) irons are classed as "octahedrites." The two are thus markedly different in character, and, apart from their widely separated localities, they evidently belong to different falls.

The Hoba meteorite easily takes the record as the largest known authentic meteorite on earth. It exceeds that of the largest mass of the Cape York meteoric irons from north Greenland, namely, the "Ahnighito" or "The Tent," which weighs $36\frac{1}{2}$ tons. This was transported by Lieut. R. E. Peary to New York City in 1897, and is now shown in the American Museum of Natural History. The Bacubirito meteorite iron, which still lies where it was found in 1863 in Mexico, has been stated to weigh 50 tons. Although 13 feet in length it is thin and tapering, and later estimates place the weight at 27 tons.

An enormous mass of meteoric iron, said to measure 100 metres in length and 40 metres in height, has been stated to have been found, together with other smaller masses, in 1921 near Chinguetti in the Adrar desert, Mauretania, French West Africa. A piece of $4\frac{1}{2}$ kilos sent to Paris was described by Prof. A. Lacroix in 1924, but there has been no confirmation of the existence of the larger mass.

Some other large meteoric masses have been inferred, but never actually found. The "Meteor Crater" near Canyon Diablo in Arizona, with a diameter of 4000 feet and a depth of 570 feet, was perhaps formed by the impact of a gigantic meteorite. Many masses of meteoric iron up to over a thousand pounds in weight have been found around the crater. Extensive boring operations have been undertaken inside the crater, but no exceptionally large mass of iron has been found.

Newspaper accounts still continue to appear about a gigantic meteor which created a great disturbance in central Siberia on June 30, 1908. After much search in the region of the Stony Tunguska River several craters have been found in the ground, but no meteorite has been discovered. One estimate places the weight of this elusive meteorite at half a million tons, whilst a more moderate estimate gives but 130 tons.

OBITUARY.

THE Museum has to deplore the loss by death on April 28, following a serious operation, of Dr. James Waterston, an Assistant Keeper in the Department of Entomology. Dr. Waterston had been for the past ten years in charge of the Hymenoptera.

Born in Paisley on February 7, 1879, James Waterston was educated at Watson's College, Edinburgh, and Edinburgh University, where he graduated M.A. (with Honours), B.D., and B.Sc. (he became D.Sc. in 1921), and in 1906 was awarded the Baxter Scholarship in Biology. He entered the ministry of the Free Church of Scotland and was for several years in charge of a parish in the Shetland Islands. Always an enthusiastic naturalist, he made various important contributions to the knowledge of the Scottish fauna and, interesting himself more especially in parasitic insects, he became a leading authority upon the Siphonaptera (Fleas) and Mallophaga (Bird-lice). In 1914 the growing recognition of the importance of Parasitology, and particularly of a better knowledge of the parasites of insect pests, led to his being offered a post in the Imperial Bureau of Entomology in London. The rigorous climate of the Shetlands having proved unsuited to the health of his wife and eldest child, he was glad to avail himself of the opportunity, and from this time threw himself energetically into the study of the Hymenoptera. During the war he held a commission in the R.A.M.C. He served at Salonika as Entomologist, and was mentioned in despatches. Unfortunately illness resulting from his war-service seems to have left permanent effects upon his constitution, to which his too early death must be attributed.

In May, 1920, he joined the staff of the Museum, where his work has dealt chiefly with the more minute Hymenopterous parasites of insects, but his unrivalled knowledge of the Mallophaga and Siphonaptera was also of great service. His large and important collections of these, to which he had devoted much time and labour, have become the property of the nation.

Waterston was a naturalist of exceptionally wide knowledge and interests, and he possessed remarkable skill in the dissection of minute insects. It is much to be regretted that, through his early death, important work is left unfinished which there is at present no one competent to carry on.

Mr. A. S. Hirst, a former Assistant Keeper in the Department of Zoology, died at sea on May 4 on his way from Australia to England. He was 46 years of age. He entered the Museum in 1905 and retired owing to ill-health in 1927. He was in charge of the collections of Arachnida, Myriopoda, etc., and was an authority on the Acari.



THE LATE DR. J. WATERSTON.

OLDFIELD THOMAS LIFT.

A PASSENGER lift for the use of the Museum staff, designed to convey four persons, has been installed in the west Central Tower of the Museum, travelling between the basement and the Cryptogamic Herbarium on the third floor. The construction of this lift was made possible by the generous gift to the Trustees



THE OLDFIELD THOMAS LIFT.

(Lord Hanworth and the Rt. Hon. G. Lansbury, M.P.).

of £1,200 by the late Mr. Oldfield Thomas, F.R.S., shortly before his death. Mr. Thomas especially wished to provide for his successors in the Mammal section a more easy means of access to their rooms than the stairs which he himself, towards the end of his long association with the Museum, found so tiring.

The lift was opened on June 6, 1930, by the Rt. Hon. George Lansbury, M.P., First Commissioner of His Majesty's Works, and was accepted on behalf of the Trustees by Lord Hanworth.

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THE HABITS AND BREEDING OF MANDARIN AND NORTH-AMERICAN (CAROLINA) WOOD DUCKS.

By VISCOUNT GREY OF FALLODON, K.G., D.C.L., F.R.S., Trustee of
the British Museum.

FOR ten years no birds have been pinioned at Fallodon, and this article is founded upon observation of birds that have never been under control. For at least fifteen years no birds have been



Copyright photograph

Seton Gordon

FIG. 1.—FEMALE WOOD DUCK ON GROUND.

reared under bantams or by any agency except that of their own parent. The ducks choose their own nesting-places, hatch their own eggs, and bring their broods on to the ponds. Wheat is scattered on the ground in early morning and at sunset in a certain place, and during the breeding season soft food for the young ducks is placed in saucers in wire-netting enclosures with a wooden bottom very little above the level of the water. These wire enclosures are fitted with sliding doors so that the entrance to them can be adjusted to admit young ducks and to exclude

adult birds. These young birds may take a few days to find the feeding-places, but they soon acquire the habit of visiting the saucers of food. Some acres of ground are protected by a fox-proof fence and all that is possible is done to destroy vermin, especially rats and stoats. With these exceptions the birds may be said to live and breed under natural conditions.



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FIG. 2.—FEMALE WOOD DUCK EMERGING FROM (left) AND STANDING ON (right) BARREL IN TREE.

These photographs were taken in March 1930. At that date the duck was only prospecting, but eventually she did make a nest in this barrel, lay eggs, and hatch a brood.

At first sight Mandarins and Wood ducks give the impression of being closely related species. The resemblances are as follows :

1. In appearance there is a resemblance between the females of both species, and some people who are entirely unfamiliar with either find some difficulty at first in distinguishing between the two ; but the resemblance seems much less when we have had long observation of both kinds.

2. The males of both species, though very different in colour, have one characteristic in common : they are both remarkable for the bright and varied colour of their plumage.

Indeed, in any collection of ducks, male Mandarins and Wood drakes are at once picked out as being the most conspicuously brilliant birds. Both have a very complete eclipse, the males going into an eclipse plumage that resembles the plumage of the females. In Mandarins this resemblance between males in eclipse and females is particularly close. The period of the eclipse is about the same, though at Fallodon one or two Wood drakes come into plumage before the Mandarins.

3. Both species have the same habit of nesting in holes in trees.

My own observation, however, points to the conclusion that the two species are in fact not so closely related as might be supposed. If the two species had been closely related, hybrids between them would have been frequent, for they are constantly kept together. I heard many years ago of one brood of hybrids being hatched, but none was reared. In 1896 one of my young birds showed some slight variation in his first plumage from that of a young male Wood duck, but he died in September before coming into adult male plumage, and it is very doubtful whether he was a hybrid. Beyond this I have never heard of a hybrid and have never had experience of any hybridization between the two species. To some extent this absence of hybrids may be due to the exclusiveness of the Mandarins. They give an impression of very high breeding and pride of race, and I have never seen at Fallodon a hybrid of any kind in which any Mandarin male or female bird had any share.

Wood ducks, on the other hand, are not so exclusive. Hybrids have occurred at Fallodon between Wood ducks and Brazilian Teal and between Wood ducks and Ring-necked Teal: in both instances the mother was a Wood duck; but this was several years ago and the erring parents were pinioned birds. In 1929 a male Wood duck paired with a female Mandarin. These birds were both unpinioned and their choice was therefore free. They were together throughout the breeding season and no male Mandarin seemed to pay attention to the duck. Like many of the Mandarins, she had the habit of flying on to my hat or shoulder and standing there to be fed by hand: the attachment of the male Wood duck was so great that he followed her example, and this first called my attention to their being paired. They attended the evening feed regularly, but as far as could be observed the duck never nested, and nothing came of the pairing. The voices and courting gestures of the two species are very distinct: in these respects there is no resemblance between them, and I am disposed to think that, in ducks at any rate, resemblance

of voice is a surer guide to blood relationship than is resemblance of plumage. For example, the plumage of the Chilian Teal is very different from that of our British common Teal: in the Chilian the plumage of both sexes is nearly alike and the male has no eclipse; in our common Teal the male in full dress is quite unlike the female and he has a complete eclipse. Indeed, from the plumage no close relationship between our Teal and the Chilian Teal would be inferred; but the voices of the two species are, if not identical, so alike as to be very difficult to distinguish. The British and Chilian Teal in my experience hybridize only



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FIG. 3.—MALE MANDARIN ON ARM OF SEAT, UP TO WHICH HE HAS FLOWN TO BE FED BY THE AUTHOR.

too readily and the hybrids are very vigorous and fertile, which is evidence of a close relationship between the two species. In like manner the kinship of the different kinds of Mallards that occur in the different continents is shown by voice rather than by plumage. I draw the conclusion that unlikeness of voice, as in Mandarins and Wood ducks, must be taken to discount resemblance of plumage and habits, which would otherwise imply kinship.

As it is the habit of both species to nest in holes in trees, and as the number of such natural holes at Fallodon is very limited, herring barrels half open at one end are placed horizontally in trees. Even so there are more birds than barrels or

holes, and it often happens that a Mandarin and a Wood duck lay in the same nesting-place. When this happens both birds may desert, leaving a clutch of mixed eggs in the barrel; but if either of the egg-layers does sit, it is invariably the Wood duck, which in appearance is the heavier and stronger bird. The consequence at Fallodon is that the Wood ducks very frequently come on to the water with a mixed brood; this provides a perfect opportunity of comparing the growth and qualities of young Mandarins and young Wood ducks. Certain differences between them are very marked and constant :—



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FIG. 4.—MALE MANDARIN (Fig. 3) ABOUT TO TAKE FOOD FROM THE AUTHOR'S HAND.

1. Young Mandarins are more clever than young Wood ducks; they are the first to find the feeding-places. They are also particularly pugnacious and bold. I have seen a little Mandarin still in down, not more than a fortnight old, run on land at an old Eider drake that was standing by my feet; the Eider was so astonished at this infant phenomenon that he made an ignominious retreat. Young Mandarins also are from the first very active in driving birds of other broods and species away from the feeding-places.

2. Young Mandarins are more hardy than young Wood ducks. Of this I had a very clear demonstration this year. A Wood duck that had nested in one of the barrels brought on to the

water a mixed brood of five Wood ducks and five Mandarin, leaving eleven unhatched eggs. She did this on a cold day in the first half of May. There was rain most of the day and a cold wind, and a cold night followed. Next morning only one of the five little Wood ducks appeared; the other four had all succumbed. All the five young Mandarins on the other hand, were alive and thriving, and all were eventually reared. I imagine their survival must have been due partly to their constitution and partly to the fact that on the cold night their innate cleverness would have led them to ensure for themselves the best and warmest shelter under the body of their foster mother, the Wood duck.

3. The young Mandarins grow faster than the young Wood ducks; this is very conspicuous in the mixed broods, where it is very easy to see the young Mandarins outstrip the Wood ducks. The gardener at Fallodon, who is a very close and accurate observer, says that Mandarins are on the wing in eight weeks from the day when they first come on to the water: the period with Wood ducks is ten weeks.

The habit of nesting in holes leads to one inconvenience: both Mandarins and Wood ducks are apt in the spring to descend chimneys. A few years ago I was told that Mandarin ducks had been found on two occasions in unoccupied bedrooms. In each instance the bird had presumably descended in the early hours and had not been found till the windows were opened later in the morning to air the room. In the interval each bird had explored the room and left much soot on the bed, chairs, and carpet. The spring cleaning of the rooms had just been finished, and the exploits of the Mandarins were not popular. Soon afterwards, when I was at home, I was awakened very early by a noise in the bedroom chimney. The noise exactly resembled that made by a chimney-sweep's brush when sweeping a chimney. It ceased: then began again: and this happened three or four times, coming lower and lower in the chimney. I waited in expectation, and presently, as I anticipated, a Mandarin duck appeared in the empty grate; had it selected the open window there would have been no further trouble, but it flew up to one of the closed windows and I had to get out of bed to catch it and to put it out of the open window. It flew away calling loudly in the air, as is the habit of the Mandarin ducks on the wing. Since then wire-netting covers are put on the chimney-pots every spring till the nesting season is over. On three occasions at Fallodon young Wood ducks have been observed in the act of leaving the nest. In one case the nest was in a hole in a tree, of

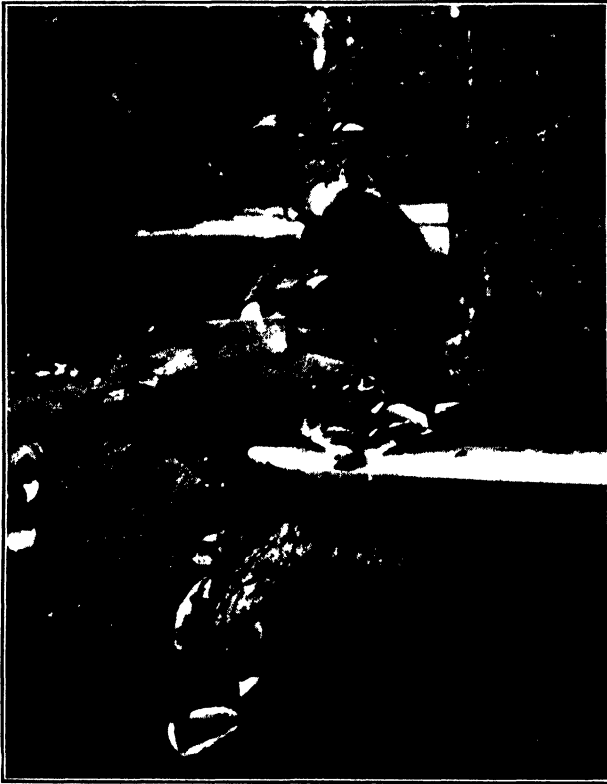
which the entrance was twenty-one feet above the ground. In the other two instances the nests were in barrels at somewhat lower heights. In every instance the young ducks fell voluntarily; no attempt was made by the mother to carry them.

In the last few years Mandarins have spread over this neighbourhood: they are seen, and nests and broods are reported many miles away. Some nest in my woods outside the fox-proof fence and some distance from the house; they are seen with their young in the little burns, and the broods thrive and grow rapidly without any food except what they can find by themselves in the burns. The young Mandarins under such conditions are very wild; they scatter in all directions at sight of a human being and grow up into wild birds. All this leads to the conclusion that Mandarins would establish themselves in a wild state in this country if they were not shot before the species had established its footing in a wild state. Experience at and near Fallodon makes me think that the same is probably true of the Chilian Teal. The Wood duck, on the other hand, would, I think, certainly not establish itself as a breeding species under natural conditions in this country.

It has already been remarked that when a Mandarin and Wood duck lay in the same nest, it is the Wood duck that eventually establishes itself in possession of the nest and eggs. From this it might be inferred that the Wood duck had some advantage; it is not so, quite the contrary. The Wood ducks frequently rear young Mandarins as well as their own kind. They are therefore engaged in adding to the number of Mandarins, whereas I have never known a Mandarin appear with any but young Mandarins. Where both kinds have laid eggs in the same nest, the dispossessed Mandarin nests again elsewhere. The result is that even inside the enclosure more Mandarins than Wood ducks are reared, whereas in the woods outside there are other broods of Mandarins, and these have spread their kind out of all proportion to the Wood ducks. At Fallodon, at any rate, Mandarins are altogether a more alert, high-spirited, enterprising, and vital species than Wood ducks.

If it is desired to have a great variety of water-fowl, to rear a large proportion of young birds, and to keep, sell or exchange them, it is essential to hatch the eggs and to rear the young under bantams and to pinion the young ducks; this used to be my object and practice. Since the exile from home that was entailed by political office came to an end and after the War was over, I have found more pleasure in letting the water-fowl nest as they please and rear their own young, in leaving them

unpinioned and free, but at the same time in having them so tame that they will feed from the hand. Immediately after the War a few birds were pinioned to secure a stock, and from time to time pinioned birds of a new species or of one which is not maintaining its numbers, are bought, but with these exceptions all the birds are unpinioned. The losses are, of course, very large. Tamelessness is no guarantee that water-fowl will not fly



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FIG. 5.—FEMALE MANDARIN STANDING ON THE AUTHOR'S
HAT TO BE FED BY HAND; ON THE SEAT ARE A
PAIR OF WOOD DUCKS.

This photograph was taken by time exposure in the dim light after sunset.

away: wildness and the migrating spirit are always in them. Many no doubt pass entirely into a wild life; many must get shot, for it is not possible to distinguish rare kinds in flight. But some stay with me and some return, and a bird that has been away many months leading a wild life will on its return feed as confidently from the hand as before it went away.

The taming of the young birds requires many hours of patient

work on the part of the gardener, of a friend who lives near, and of myself. It is essential that the parent birds should be tame : if they are not and if they give the alarm to the young there could be very little success. But even when the parents bring the young near and encourage them, the young of most species are suspicious of the human hand. When, however, they get quite used to the sight of human beings and find out that a hand is a source of food supply, the more intelligent birds become very confident. Individuals in the same brood will differ in this respect; young Mandarins especially, though shy at first, respond very rapidly to coaxing. Some years ago a Mandarin duck discovered that to fly up and stand on the head or shoulders of a man who had food gave a position of vantage over the other birds and secured immediate attention. Others have followed this example, and at the evening feed there is often great competition for these positions. The scuffling thus caused is sometimes embarrassing and in wet weather the feet of the birds may leave some traces of mud, but so far as my own experience goes, and that of the gardener and of my friend, Mandarins treat the human form with as scrupulous a regard for cleanliness as they do their own nests, and neither hats nor clothes suffer.

Both Mandarins and Wood ducks, especially the former, often perch in trees at all seasons, not in the nesting season only. Once in the autumn while taking a guest round my two ponds, I was unable to show him a single Mandarin till he found eight birds in a laburnum tree. Mandarins when free and tame are a source of interest and delight, and to watch at very close range a dozen or more of the males engaged in courting display on the water is a rare entertainment.

TWO REMARKABLE CEPHALOPODS.

By G. C. ROBSON, M.A., Assistant Keeper, Department of Zoology.

MODELS of two rare and remarkable Cephalopods have been recently placed on exhibition in the Mollusca Gallery. One of these, the Black Octopod, *Melanoteuthis beebei*, is in Wall-case F (east wall), the other, the Stalk-eyed Squid, *Bathothauma lyromma*, is in the case containing the model of a Giant Squid in the central aisle of the Gallery.

Melanoteuthis beebei is known at present from a single specimen obtained in 1925 by Dr. William C. Beebe, Director of the New York Zoological Society's Department of Tropical Research. It was trawled from a depth of 750 fathoms in the eastern Pacific

not far from the Galapagos Islands. The external surface of the animal is entirely black. The pale colour of the mantle-cavity shows through the curved mantle-aperture and gives the animal the appearance of a grinning mask, when viewed from the ventral surface.

Melanoteuthis is a member of a group of deep-water Octopods which have only quite recently been made known to science. They have a superficial resemblance to the abyssal and highly modified forms known as the Cirromorpha. They are, however, the most primitive of all the living Octopods and their structure

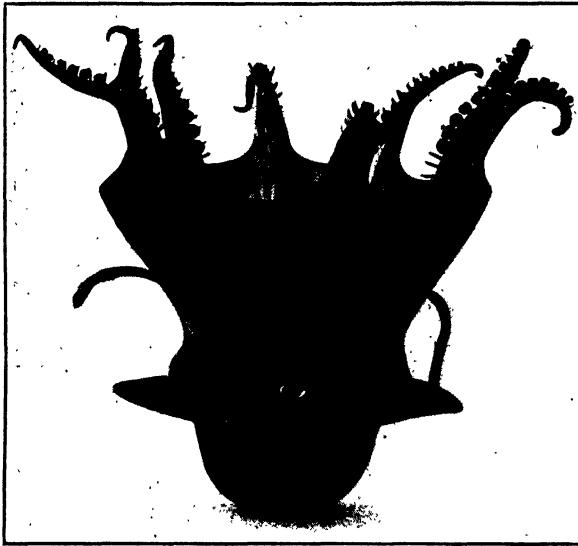


FIG. 1.—MODEL OF THE BLACK OCTOPOD
(*Melanoteuthis beebei*).

casts a great deal of light on the evolution of the Cephalopoda. *Melanoteuthis* and its allies are equipped with special light-organs, and the slender filaments seen hanging down each side in the model are supposed to be vestiges of a fifth pair of arms.

Up to the present time only two examples of *Bathothauma lyromma* have been described. One was caught at a depth of about 1640 fathoms by the "Valdivia" Expedition off the Cape Verde Islands. The other was obtained in the eastern Pacific by the United States Fish Commission Steamer "Albatross." A third example has just been obtained by Dr. Beebe and is figured in the current number of the Bulletin of the New York Zoological Society. The bizarre appearance of this remarkable animal does not need much demonstration. The long eye-stalks, massive tentacles, atrophied arms and fins and

the elongate "neck" distinguish it at once from the less specialized squids, such as *Loligo*, *Stenoteuthis*, etc., to which it is related. The members of the particular family to which it belongs have abandoned the vigorous mode of life characteristic of the other squids and have become more or less passive floating animals. One looks in vain, however, for a suitable explanation of the special modifications seen in *Bathothauma*. Perhaps the

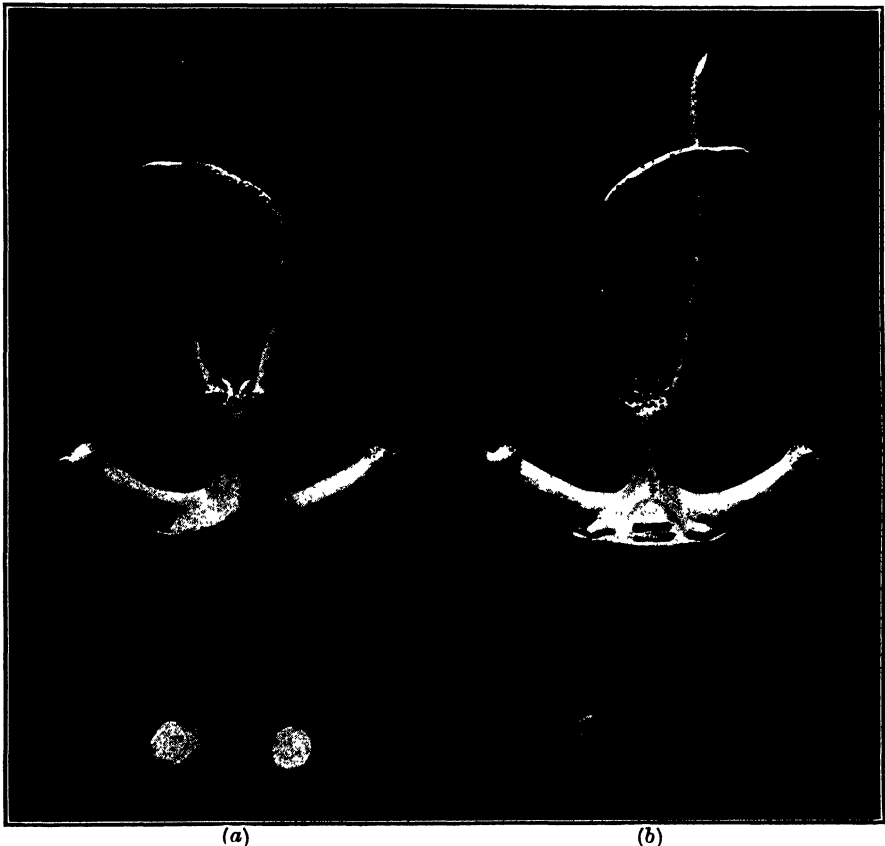


FIG. 2.—MODEL OF STALK-EYED SQUID (*Bathothauma lyromma*).

(a) Dorsal view.

(b) Ventral view.

most remarkable of these is the elongation of the head-region to form a flexible "neck," at the end of which we see the very much reduced arms surrounding the mouth, and the tentacles. As the arms are used in less specialized squids for holding the prey while it is being gnawed by the animal, one must suppose that some change in feeding-habits is associated with the atrophy of these organs.

A YOUNG GRANT'S ZEBRA.

By J. G. DOLLMAN, B.A., Assistant Keeper, Department of Zoology.

AMONG recent accessions presented by the Rowland Ward Trustees is a young foal of Grant's Zebra, or Highland Quagga of East Africa, *Equus quagga granti*. This race of quagga was originally described by De Winton from the Thika-Thika Valley, Kenya Colony; the range extends throughout the highlands of Kenya Colony from Mount Kenya to as far west as Mount Ruwenzori. In the south it reaches as far as Tanganyika Territory and in the north enters Uganda and the Northern Frontier Province of Kenya Colony; a zebra described from Abyssinia under the name of *Equus jallæ* is probably identical with *Equus quagga granti*. A closely allied race is Cuninghame's bonte-quagga (*Equus quagga cuninghamei*) described from the valley of the northern Guaso Nyiro.

The name "zebra" should, strictly speaking, be confined to the true zebras, often termed the mountain zebras, which differ from the bonte-quaggas in the possession of a well-marked dewlap; the ears are longer, the hoofs are narrower, and the tail-tuft is less bushy. Further, the rump is marked by a series of transverse bars forming what is called the "grid-iron" pattern.

Grévy's Zebra (*Equus (Dolichohippus) grevyi*), from Abyssinia, Somaliland, and Lake Rudolf district, represents a second type of zebra and is one of the most northerly representatives of the striped group of the family *Equidæ*. It differs markedly from both the typical zebra and quaggas. The callosities on the fore-legs are quite small, the mane extends on to the withers, while the ears are large and broad, very different from the narrow, pointed ears of the other groups. The striping of the coat is also strikingly different, the stripes being remarkable for their narrowness.

The quagga and bonte-quaggas represent the third group of zebras, the quagga being an extinct animal, which was at one time very common in Cape Colony and the Orange Free State. About the year 1843 quaggas inhabited the plains of South Africa in very large numbers, but since that date they have been gradually killed off, and one of the last survivors died in the Zoological Society's Gardens in 1864. Gordon Cumming relates how at one time during his visit to the flats adjoining Thebus Mountain scarcely an hour elapsed during daylight when the noise of the "sportsmen's" guns could not be heard. The quagga differed from all the other striped zebras in that the striping was

developed only on the face, neck and shoulders, the hind part of the body being uniformly brownish and the limbs white. The bonte-quaggas, of which several different races have been described, are distributed over a great part of South Africa and spread northwards up the east side of the continent as far north as Abyssinia. Included amongst these bonte-quaggas are the

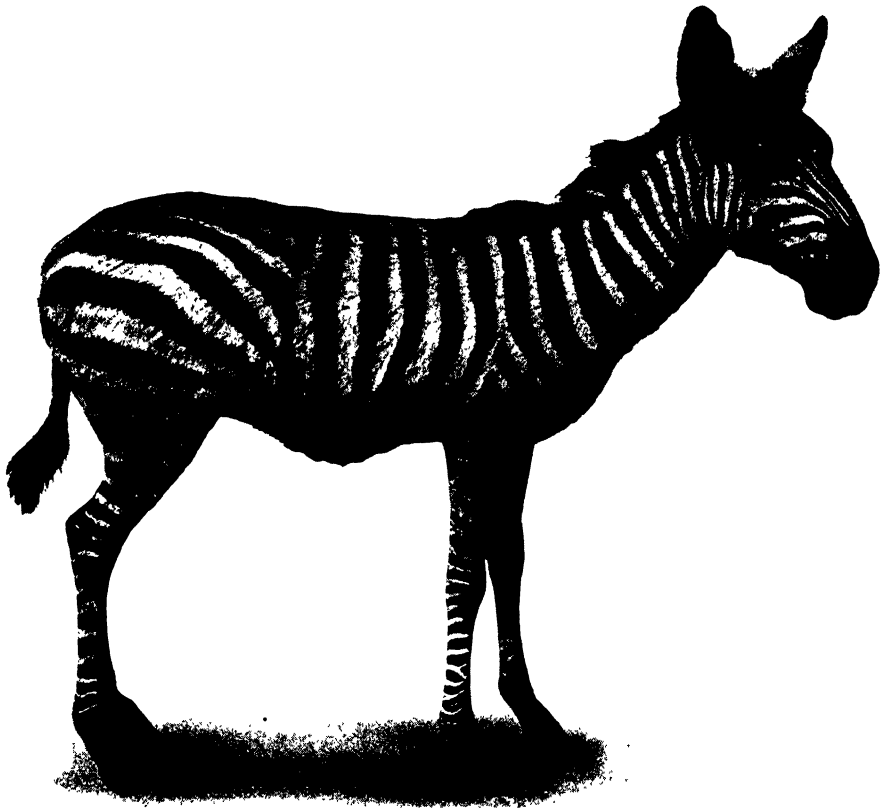


FIG. 1.—A YOUNG GRANT'S ZEBRA.

following well-known animals: Burchell's zebra (*Equus quagga burchelli*) which formerly inhabited British Bechuanaland, the Zulu bonte-quagga (*Equus quagga wahlbergi*), and the two races mentioned above.

At some future date it is hoped to make use of the new specimen in a group of Grant's bonte-quaggas, but for the present it is exhibited in one of the cases in the Lower Mammal Gallery close to the large case of zebras. The specimen was mounted in the Rowland Ward studios.

A REMARKABLE SEPTARIUM FROM SOUTH WALES.

By W. CAMPBELL SMITH, M.C., M.A., Assistant Keeper, Department of
Mineralogy.

THE half of a septarian nodule of quite exceptional beauty of form has recently been presented to the Museum by Mr. A. S. Hodgson of Pentre, Glamorganshire, who had it from one of the collieries, either Abergorky or Dinas, in the Rhondda Valley. The exact locality and horizon from which the specimen was obtained are therefore uncertain, but it may be safely

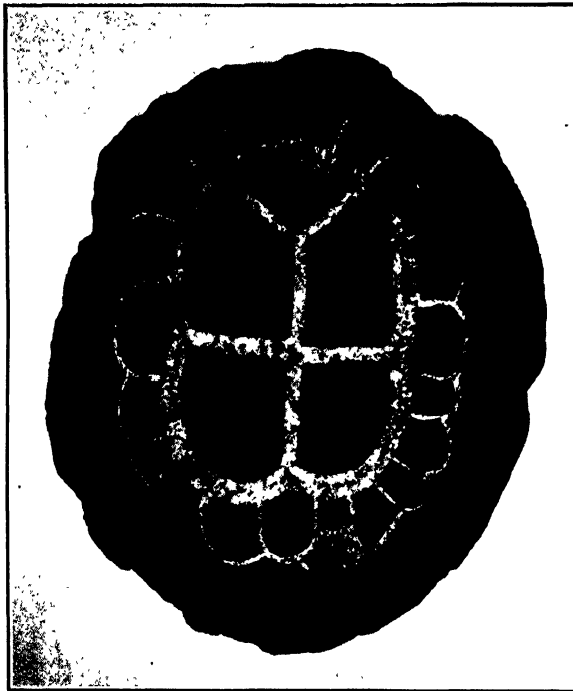


FIG. 1.—SEPTARIUM FROM SOUTH WALES.

suggested that it came from one of the many beds of ironstone associated with the shales of the Lower Coal Series of the Rhondda Valley.

The nodule consists of clay-ironstone, sooty black in colour, elliptical in outline and measuring 26 by 22 cm. along its major and minor diameters, and $4\frac{1}{2}$ cm. in thickness at the centre. The septa are formed of glistening white ankerite, a carbonate of calcium, magnesium, and iron. Their remarkable regularity is well shown in the photograph reproduced above (Fig. 1). The

inner ellipse and the scalloped edge which borders it are concentric with the outline of the section of the nodule. None of the septa reaches the surface, minute radial cracks dying out towards the edges and leaving an unbroken rim about 2 cm. thick all round. The central right-angled cross cracks were probably the first to form. They are remarkably uniform in width and in direction. The inner ellipse, slightly drawn in at its junctions with the central cross, is 1 cm. wide and is open for part of its length where crystals of ankerite growing out from its walls fail to meet.

The process by which the cracks formed within the body of the septaria, often without reaching to, or showing any effect at the surface, and became filled by minerals quite different in composition from the main substance of the nodule, has been the subject of speculation since the beginning of the last century.

Septaria form as concretions in argillaceous sediments. They consist usually of argillaceous limestone or clay-ironstone and the cracks within become filled with crystallized carbonates free of clayey matter. In simple forms, which are rather scarce, the septarian structure may be merely four cracks meeting approximately at right-angles and near the centre, but as a general rule the septa form a pattern which is some rough variation of the remarkably symmetrical example here described.

James Hutton* considered the structure could only result by crystallization on cooling from a fused state, and he claimed the presence of septaria as evidence of the igneous origin of the argillaceous rocks in which they lay. This view was supported by Playfair† and also by Erasmus Darwin,‡ who added some further explanation of the process, more curious than correct.

In order to realize the importance which was attached to this explanation of septarian structure it is necessary to recall the bitter controversy between "Neptunists" and "Plutonists" which raged at the beginning of the nineteenth century. By 1851, however, this controversy had died down and we find De la Beche§ describing the septaria along with other concretions in sedimentary rocks without even referring to it.

* Hutton (James), *Trans. Roy. Soc. Edinb.*, 1788, vol. 1, p. 246, and pl. 1. The plate illustrates a good septarium from Aberlady, East Lothian.

† Playfair (John), "Illustrations of the Huttonian Theory of the Earth," 1802, p. 30.

‡ Darwin (Erasmus), "The Botanic Garden . . .", 1791, Additional notes, p. 39.

§ De la Beche (Sir H. T.), *Geological Observer*, 1851, p. 687.

As early as 1815 Dr. C. H. Wilkinson,* of Bath, had shown that cracks, formed during the drying of sea-soaked blocks of argillaceous limestone, became filled with calcite like the septa of septaria.

An explanation of the septarian structure by the contraction of the interior became fairly generally accepted and appeared in the text-books of Sir Archibald Geikie and others. Different views from this, however, were still held, and an explanation depending on the supposed expansion of the outer layer by infiltration of calcite was put forward by H. G. Seeley† and later by A. Morley Davies.‡

The subject was reviewed in 1918 by W. A. Richardson,§ who showed how like are the patterns of septaria to the cracks produced in drying mud, and he succeeded in reproducing similar systems of cracks in balls of clay. He considered that the cracks were due to desiccation of an originally colloidal centre by chemical means, the filling of the cracks taking place after their formation, and sometimes not being completed. Richardson clearly regards the infiltration of calcium carbonate or other mineral infilling as possible, and Geikie || seems to have regarded it as certain. It was the difficulty of reconciling this idea of *addition* of calcium carbonate with an apparent *contraction* in volume that led Morley Davies to seek an "expansion" explanation. It is conceivable, however, that the vein-filling material was already present in the concretion intimately mixed with the clay, and that the nodules, with their outer surface undisturbed, contain their original constituents in nearly the same proportions but separated in the process of drying into the compacted clay of the "tali" ¶ and crystallized calcite of the "septa."

Although it is true that in many septaria the cracks do not reach the surface, there are others in which the septa do appear at the true surface of the concretion or even project beyond it. This is not due, as Playfair supposed, to the exfoliation of the surface of the concretion. In any perfect specimen it can be seen that portions of the surface between the septa are convex,

* *Thomson's Ann. Phil.*, 1815, vol. 6, pp. 408-9.

† "Phillip's Manual of Geology," part I, edited by H. G. Seeley, 1884, p. 103.

‡ *Geol. Mag.*, 1913, dec. 5, vol. 10, pp. 99-101.

§ *Min. Mag.*, 1919, vol. 18, pp. 327-38, 1 pl.

|| Geikie (Sir A.), "Text-book of Geology," 1903, vol. 1, p. 136.

¶ *Tali*, the name given in early descriptions of septaria to the parts between the septa; literally, oblong dice marked for scoring only on four sides.

like the plates on a tortoise-shell, the septa resembling the sutures. Stones of this kind, no doubt, were the first to be given the name "turtle-stone," which has now become extended to all septaria in which the markings on the surface or on the section resemble the pattern of a tortoise-shell.

Another popular name for some of the septaria is "beetle-stone." These are small smooth oval nodules veined with calcite found in shales with beds of ironstone in the Millstone Grit formation of the Tenby district of Pembrokeshire.*

The present name, septarium, appears in mineralogical literature about the middle of the eighteenth century, but the earlier English name was "Waxen Vein." This referred to the colour of the calcite forming the septa, for the first known British septaria seem to have been those of the Isle of Sheppey, better known now for the rosettes of barytes which are sometimes found in them. One of them is figured in plate 21 † of Dr. Grew's Catalogue of the Royal Society's Museum as "Starred Waxen-Vain" (*sic*).

Around the early Latin nomenclature of septaria there arose a certain amount of confusion which was not merely of academic interest. Paracelsus (or Hohenheim), a doctor, philosopher, and chemist who died at Salzburg in 1541, had described by the name of *ludus* a stone from which could be made a preparation alleged to possess the property of dissolving calcareous concretions in the human body.

The name *ludus* appears to have been suggested to Paracelsus by the resemblance in shape of the stone to dice used in the *ludus tesserarum*. His description of it seems, however, to have been none too clear. Jan Baptista van Helmont, a doctor and chemist of Brussels (1577–1644), thought he had identified it with yellow-coated "tali" of septaria found near Antwerp, and to these he gave the name *ludus* too, and ascribed to them the same remarkable medicinal properties as Paracelsus had done. Next Dr. Grew in 1681 recognized in van Helmont's description the Waxen Vein of the Isle of Sheppey and recounted the virtues of the stone, but cautioned his readers against such medicines. Five years later, however, in his "Natural History of Staffordshire," ‡ Dr. Plot described as the *ludus* of Paracelsus cubic crystals of *pyrites aureus*, which clearly were different

* Dixon (E. E. L.), *Mem. Geol. Surv. Eng. and Wales*, 1921, "The Geology of the South Wales Coalfield," part 13, pp. 147 and 154.

† Grew (N.), "Museum Regalis Societatis . . .", 1681, p. 312, pl. 21.

‡ Plot (Robert), "The Natural History of Staffordshire," 1686, p. 188 and pl. 12, fig. 1.

from the *ludus* of Helmont. Whether Dr. Grew was aware of Robert Plot's opinion as to the true nature of the *ludus Paracelsi*, or whether Dr. Plot knew that van Helmont held a quite different opinion one cannot tell, nor is it known if either of them tried their strange medicines, but in 1729 we find John Woodward * discovering the state of confusion produced by the learned doctors and setting himself to put it right. This he did by obtaining through the good offices of Sir Isaac Newton specimens of *ludus Paracelsi* from Saxony and of *ludus Helmontii* from Antwerp, the latter supplied by van Helmont's son himself. The *ludus Paracelsi* was identified as a "tes-selated pyrites," while the *ludus Helmontii* did not differ in anything but colour from the English "Waxen Vein." This opinion of John Woodward may be said to have settled the matter, for the specimens could, and still can, be examined side by side in the collection which is still preserved in the Sedgwick Museum at Cambridge under the special care of the Woodwardian Professor of Geology.

EXHIBITION OF HISTORICAL COLLECTIONS IN THE DEPARTMENT OF BOTANY.

By J. RAMSBOTTOM, O.B.E., Keeper, Department of Botany.

FOLLOWING on the Fifth International Botanical Congress which was held at Cambridge August 16th–23rd, an exhibition of a selection of the historical collections was arranged in the Department of Botany on August 25th and 26th. Each visitor was presented with a descriptive pamphlet and a photograph of the general herbarium. Tea was provided by the Government Hospitality Fund.

The pamphlet described the growth of the plant collections from the purchase of the Sloane collections in 1753 until the formation of the Botany branch of the Natural History Department in 1835, and gave a summary of the main contents at the present time.

The Sloane Herbarium is still kept in the original 333 volumes. It is the largest pre-Linnean collection in existence and contains the plants collected by James Cunningham in China in 1698–1703; those from the Philippines by Kamel sent to Petiver in 1701 and described in the Appendix to Ray's "Historia Planta-

* Woodward (J.), "An attempt towards a Natural History of the Fossils of England," 1729, pp. 83 and 84.

rum"; the collections of Petiver and Plukenet containing a large number of the plants figured and described in their works; American plants from Banister, Bartram, Catesby, Houstoun, Krieg, and Vernon; the collections of Hermann and Oldenland from the Cape of Good Hope; Kaempfer's plants from Japan (1691); plants from Jussieu, Tournefort, and Vaillant; and those of most of the contemporary English botanists—Buddle, Doody, Philip Miller, Merrett, Ray, Sherard, and Uvedale.

Several volumes of these were shown: a volume of the eight containing Sloane's specimens collected in Jamaica (forming the basis of his "Natural History of Jamaica") and the original drawings, and one each of Petiver, Boerhaave, Buddle, Catesby, Cunningham, and Oldenland.

In the first sixty years of the Museum's existence few additions were made to the Botanical Collections. The principal one was the presentation by the Royal Society in 1781 of their herbarium (established 1719) and the tributary plants from the Chelsea Physic Garden: Sir Hans Sloane, when he bought the Manor of Chelsea in 1722, presented the Garden to the Company of Apothecaries (who had founded it in 1672) for an annual payment of £5, but stipulated that every year for forty years, fifty specimens of plants all grown in the garden and no two alike, carefully dried, mounted and named, should be sent to the Royal Society. Plants continued to be sent to the Royal Society until 1796, and the specimens exhibited show how well the Apothecaries carried out the terms of the bequest.

The continued interest in the Department was shown by the Apothecaries' Company in 1862, when they presented the valuable European Herbarium of John Ray (1627–1705), contained in four cases. The herbarium had been bequeathed to the Society by Samuel Dale; the gift also included the herbaria of Dale, Rand, and Nicholls. A further connexion with the Chelsea Physic Garden is the possession of Philip Miller's herbarium. When Sloane became landlord of the Garden in 1722, Miller was appointed Curator. He became noted as a botanist as well as a skilful gardener, and his "Gardener's Dictionary," the eighth edition of which (1776) adopted the Linnean nomenclature, had a profound influence on horticulture. The herbarium included the large herbarium of Houstoun and plants from Gronovius. It was purchased by Sir Joseph Banks.

The Department of Botany began its separate existence in 1827, when Robert Brown, who had a life interest in Sir Joseph Banks's collections agreed to their transference to the nation during his lifetime, and became "Keeper of Sir Joseph Banks'

Botanical Collections," with J. J. Bennett as Assistant. The Sloane and other collections were transferred to Brown's custody in 1835.

Sir Joseph Banks, Trustee of the Museum, acquired the most extensive herbarium of his time. At a period which was ripe for botanical exploration, Banks by his example and his wealth was able to stimulate collectors in many parts of the world. He began his botanical travels by collecting in Newfoundland and Labrador (1766) and acquired fame by accompanying Captain Cook on his voyage around the world in the "Endeavour" (1768-72). Banks equipped the natural history section at his own expense (said to be £10,000). He took with him Dr. Daniel Solander, one of Linnæus's favourite pupils, and selected by him on the request of John Ellis and Peter Collinson to encourage the study of natural history in England, and at that time an Assistant Keeper in the Museum; also a staff of draughtsmen. The full scientific results of the expedition were never published, though some of the drawings were issued in 1900-5. An exhibit showed the progress of the work up to the elegant flora of Solander and the coloured drawings and copper-plate engravings made from the sketches and notes of Sydney Parkinson, who died on the homeward voyage; and in addition manuscript floras of the Cape of Good Hope, Java, Tierra del Fuego, the Society Islands, Australia (New Zealand), and New Holland (Australia).

By purchase and by gift Banks acquired many collections of great historical value. Thus though on Linnæus's death Banks made a bid for the Linnean herbarium to the widow, and when the young Linnæus died passed on the offer of the collection to J. E. Smith, much Linnean material was in Banks's possession. This was exhibited under four heads: (1) Specimens from Linnæus's herbarium presented by Sir J. E. Smith to Sir Joseph Banks. (2) *Hortus Cliffortianus*, a collection of 3000 specimens forming the types of Linnæus's *Hortus Cliffortianus*, and consequently of many of the descriptions in the "Species Plantarum." Linnæus had become acquainted with George Clifford, a director of the Dutch East India Company, when on a visit to Holland in 1735, and entered his service for the purpose mainly of arranging and enlarging the herbarium. The collection was purchased by Banks at an auction in Holland in 1791 for £23. (3) *Flora Zeylanica*. This collection, formed by Paul Hermann, is contained in four volumes. Hermann was in Ceylon (c. 1672-77) as chief medical officer to the Dutch East India Company. Linnæus based his "Flora Zeylanica" (1747) upon it, and most

of the names on the sheets are in Linnæus's hand. Many of the descriptions of the "*Species Plantarum*" are based on those of the "*Flora Zeylanica*." (4) Specimens given by Linnæus to Gronovius and acquired with his herbarium.

In Gronovius's herbarium also are included John Clayton's plants, which were sent to Gronovius with descriptions and written up in the "*Flora Virginica*" (1743). Other historical American collections shown were those of John Bartram (1699–1777) and William Bartram (1731–1823). John Bartram was the founder of the first Botanic Garden in the New World and an assiduous explorer and collector. He sent his diary, collections of dried plants, and many seeds and living specimens to Peter Collinson in return for tulips, carnations, clothes for his eleven children, and money towards the expenses of his collecting expeditions. Collinson and Solander used to examine together his parcels, and a number of specimens from Georgia and Carolina collected in 1765–6 were preserved in Herb. Banks. William Bartram carried on his father's investigations and in 1784 explored South Carolina, Georgia, Florida, and Alabama at the expense of Dr. Fothergill. His journal, plants, drawings, and paintings are in the Department.

Banks's influence on exploration is seen in many of the collections. The most important of these is that made by Robert Brown, who together with Ferdinand Bauer as artist accompanied Captain Flinders in the "*Investigator*" to Australia (1801–6). The plants were described in Brown's "*Prodromus*," but were not definitely made over to the nation until 1876. The manuscript diary of Brown's voyage, which was exhibited, forms an important and useful supplement to the "*Prodromus*."

Ferdinand Bauer made 1542 sketches during the voyage and began to publish them in 1813. The completed drawings in the Department are rivalled only by those of his elder brother, Francis Bauer. Francis Bauer came to England in 1788 and was employed to make drawings of the plants which flowered in Kew Garden, for Banks after his appointment as Honorary Superintendent of the King's Garden did much to further horticulture by sending out collectors to obtain seeds and at the same time herbarium specimens. Bauer was also interested in plant diseases, and his "*Diseases in Corn*" shows a wonderfully clear grasp of microscopic detail. His series illustrating "*Germination and Vegetation of Wheat*" and his drawings of pollen grains were also shown.

Plants and drawings in the Department which represent Banks's interest in obtaining seeds for the Royal Garden and

at the same time enriching his herbarium are those of the *Hortus Kewensis* (1789–1810). The two Aitons, father and son, were successively Directors of Kew Garden. In that capacity they sent the novelties grown there to Banks, and these were described by his librarian-botanists Solander, Dryander, or Brown. The manuscript and most of the drawings are in the Department. Francis Masson, one of the under gardeners at Kew, was sent to the Cape of Good Hope (1774–6) under the auspices of Sir Joseph Banks. He sent home numerous living plants for the Garden and dried specimens to Banks: also a portfolio of coloured drawings.

Three collections presented to Banks were shown, namely: João de Louriero (1710–91), collection of Cochinchina plants, valuable as his main collection was destroyed. Archibald Menzies (1754–1842), collections from West America, Australia, and Pacific Islands (and an additional collection acquired by exchange from New College, Edinburgh), and Thomas Hardwicke (1757–1835), drawings and specimens of North West Indian plants.

In addition to those already mentioned, drawings by George Ehret were shown, including those of the more interesting Newfoundland plants collected by Banks; also a manuscript biography of Ehret: the original drawings by James Sowerby for J. E. Smiths' (Sowerby's) "English Botany": the working drawings of M. J. Schleiden, many being anatomical and cell studies connected with his "Grundzüge": selections from the large collection of original illustrations of the larger fungi, by Worthington G. Smith, Sowerby, Greville, Bolton, and others; J. G. Simula's "Flora Exotica" (1720), containing superb coloured drawings of flowers which were in cultivation at that time, most of them named; and R. A. Salisbury's working drawings and manuscript. A selection from de Bary's collection of 4429 microscope-preparations were shown, and also some of the volumes of Berkeley and Broome's correspondence, which gives an idea of the development of mycology during about fifty years. Many other smaller exhibits were lumped together under the heading "Miscellanea," and the principal acquisitions for 1930 were also shown.

A NEW PLESIOSAUR FROM WARWICKSHIRE.

By W. E. SWINTON, B.Sc., Assistant Keeper, Department of Geology.

DURING the latter part of the last and the beginning of this century the cement and brick clay quarries of England formed one of the most prolific sources of fossil reptile material; but times have changed and the introduction of mechanical methods of excavation, with the use of the steam shovel which grinds rock and reptile in its indiscriminate jaws, though of commercial advantage, has robbed the palæontologist of many a prize. In these days the extinct creature is more likely to enter the Museum as a constituent of its fabric than as part of its collections. Fortunately there still remain some organizations which combine mechanical methods and a thought for the commercial future with an appreciation of the geological past and the traces of extinct

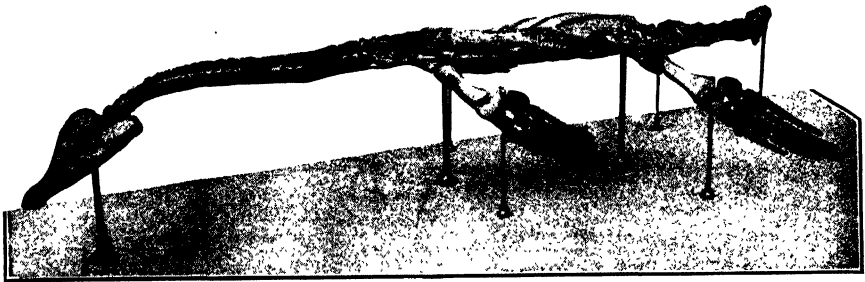


FIG. 1.—SKELETON OF *Macroplata tenuiceps*.

life occasionally brought to light. To this small group belongs the firm of Messrs. Greaves, Bull and Lakin, whose cement works at Harbury, near Leamington Spa, have within recent years yielded more than one specimen of scientific and popular interest which has been presented to the Natural History Museum.

In January 1928, while excavating the limestone, the steel shovel struck the remains of a large fossil animal, and steps were at once taken to examine the find. The shovel was stopped and the excavation continued by hand. Soon the whole surface of the creature was exposed, and the authorities at the Natural History Museum were informed, with the result that shortly afterwards the remains of the plesiosaur (as the animal proved to be) were sent to London and presented to the Trustees of the Museum by the parent cement organization, the Portland Cement Selling and Distributing Co., Ltd.

The long task of freeing the bones from their limestone matrix, of assembling, and occasionally restoring them, has recently been completed by Mr. L. E. Parsons in the workshops of the Geological Department, and the unusually fine skeleton

is now on exhibition. The specimen thus displayed is one of the most complete plesiosaurs known and is of considerable scientific importance (Fig. 1).

During the late Triassic and the Jurassic periods two groups of reptiles well adapted for a marine existence lived in the seas. The first of these is the Ichthyopterygia, or ichthyosaurs, while the second group contains the plesiosaurs. Remains of both these great groups have frequently been found in the Liassic rocks of Warwickshire.



FIG. 2.—RESTORATION MODEL OF THE PLESIOSAUR.
(Modelled by Vernon Edwards.)

There are several genera and many species of plesiosaurs, but in general those of the Lias are characterized by possessing a small or moderately large skull, a long neck, barrel-shaped body, and a tail somewhat shorter than the body. Swimming was accomplished by means of four paddles formed by the modified limbs. The skin, so far as can be ascertained, was smooth, and in some respects the creature must have resembled during life a large and long-necked, but shell-less, turtle. A restoration-model of the Harbury specimen is shown in Fig. 2.

This new specimen is remarkable for its preservation; the skull, the entire vertebral column (with the possible exception of two centra), the shoulder and pelvic girdles which are so important for classification, and the humeri and femora are all in good condition and well shown. Examination of these features clearly shows that the specimen cannot be placed in any of the genera so far established, and accordingly it has been described as a new genus and species under the name of *Macroplata tenuiceps*.*

The total length of the skeleton is 15 ft. 3 in., of which the skull takes up nearly 2 ft., the neck and tail measure 4 ft. each, while the trunk is about 5 ft. 4 in. long. The skull is complete

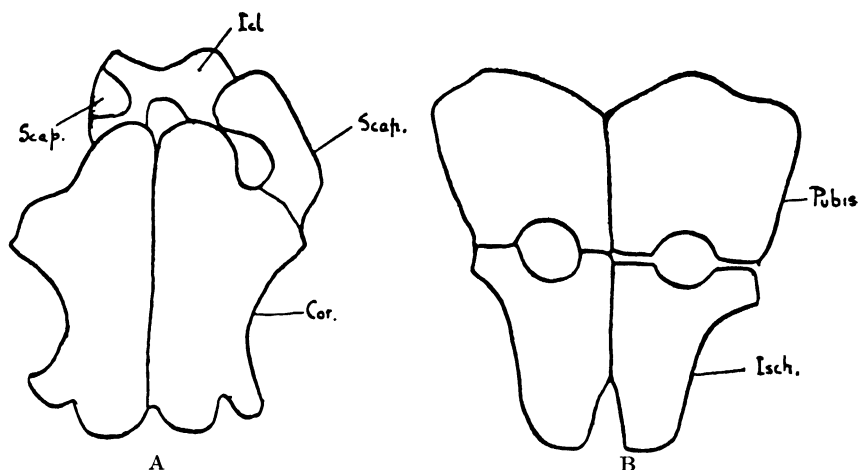


FIG. 3.—SHOULDER AND PELVIC GIRDLES OF *Macroplata*.
(About $\frac{1}{15}$ natural size.)

- A. Pectoral Girdle. Icl. = Interclavicle; Scap. = Scapula; Cor. = Coracoid.
B. Pelvic Girdle. Isch. = Ischium.

but, owing to the lower jaw being crushed upon it, the palatal aspect is obscured. The upper surface is long, narrow, and sub-triangular with large orbits. When the skeleton was discovered much comment was made in the Press on the fact that a third, or pineal, "eye" was present. This feature, common on the skulls of many fossil reptiles, is shown on this specimen by a small depression on the parietals. The function of the "eye" is obscure, but probably it was an organ sensitive to light rather than a visual one. About thirty teeth are left in the skull, and all are of the usual conical and ridged plesiosaurian type.

The vertebral column is, as has been said, almost entire.

* Swinton, 1930, *Ann. Mag. Nat. Hist.*, ser. 10, vol. 6, pp. 206-209.

The atlas and axis are preserved together with 27 cervicals, which increase in size gradually from the front to the back of the neck. The centra are moderately long and broader than high. The anterior cervicals have one rib facet on each side which splits into two in the more posterior vertebræ, the actual separation being completed at the 25th cervical. These centra are followed by 5 pectoral and 19 dorsal vertebræ, which are larger than the cervicals and almost smooth. The neural spines are unfortunately broken away in every case. The dorsals are followed by 4 sacral vertebræ and 30 caudals. The last named have the articular surfaces more deeply cupped and the non-articular surfaces more rugose than any of the preceding centra.

The ventral surface of the specimen displays the girdles very well. Only the left sides are complete, but there are portions of the right and it is easy to reconstruct the whole arrangement (Fig. 3). The coracoids are long and narrow with a considerable preglenoidal extension which does not diminish in width. The hind margin of each is remarkable in having a conspicuous triangular indentation. Only traces of the clavicles are to be seen and the one scapula present is incomplete. The interclavicle, however, is well preserved. It is comparatively narrow and long, markedly concave in front and meeting both coracoids behind. As it is strongly indented in the middle of its posterior margin it encloses with the coracoids a foramen of quite considerable size.

The pelvic girdle is composed of the pubes, ischia, and ilia, but the last are not well shown on this specimen. The pubes are rectangular plates 11 inches long and nearly 12 inches broad, while the ischia are of the customary hatchet shape and are 12 inches long and 9 broad. The girdle is therefore a great bony plate on the ventral surface about two feet long and a foot and a half broad. As the pectoral girdle is about two feet long also and slightly less broad, it will be seen that the under-surface of the creature was very well protected just under the skin. The neck and tail were thin but the body was broad and somewhat flattened.

So far as the limbs are concerned the femora are slightly longer and stouter than the humeri, a condition not unusual in the plesiosaurs but rare in other aquatic animals. Both sets of bones are a little more than a foot long, so that the complete paddles must have measured nearly four feet. The tibia and fibula of the left side were also found, but all the remaining paddle bones are lost and have had to be reconstructed in plaster.

Despite these missing bones the specimen is unusually complete and free from distortion. Furthermore, there still remains some evidence of its food, as during the preparation of the abdominal region numbers of little hooks of a cuttle-fish, *Geoteuthis*, were found. Some ammonites embedded in the matrix give the exact geological age of the plesiosaur as the *Schlotheimia angulata* zone, i.e. about the beginning of the Lower Lias.

This new specimen, therefore, in being so complete and referable to a definite horizon, is of great importance in the understanding and classification of the Lower Lias plesiosaurs, and is a discovery of no little importance. This is not the place to enter into a discussion of its relationships, but it is a specimen worthy of close inspection and is now excellently displayed in a large case immediately within the entrance to Gallery VI in the Geological Department.

RECENT IMPORTANT ACQUISITIONS.

THE zoological and botanical specimens, collected during Lord Howard de Walden's expedition to Uganda and the Eastern Belgian Congo, which have been presented to the Museum, are among the most important accessions received of recent years, and, apart from any new species or subspecies among them, a preliminary examination has revealed the presence of many animals new to the Museum collection.

The expedition left Fort Portal for the Semliki Valley on February 17 of this year. Collecting was carried out within twenty miles of Lake Albert, afterwards in a south-westerly direction to the Semliki Valley, and on March 7 into the Congo. The route then led up the western escarpment of the Semliki Valley to Mboga and west into the Ituri Forest. On March 29 the expedition divided, the one party proceeding south to Beni and the other going west to the Ituri River. Both parties came out of the Congo via Irumu and crossed Lake Albert into Uganda on the homeward journey during the month of May.

Lord Howard de Walden, in addition to spending some time with the expedition in the forest area, made a special trip to the Birunga Mountains lying to the north-east of Lake Kivu, with the object of photographing the Eastern Gorilla (*Gorilla gorilla beringeri*) and its habitat. Not only did he secure numerous photographs of the gorilla country, but he also prepared coloured sketches of the natural habitat of this great ape.

The personnel of the expedition to the Ituri and Semliki Valleys, in addition to Lord Howard de Walden and Dr. Avery, consisted of Mr. R. Akroyd, who as well as organizing the expedition did valuable work as a collector of the larger mammals; Captain F. A. B. Holloway, who concentrated chiefly on Invertebrates, making a large collection of butterflies and other insects; and Mr. R. W. Hayman, a member of the Museum staff, who specialized on the medium-sized and small mammalia. Two white hunters accompanied the expedition as guides and supervisors of the safari; the latter, on account of the quantity of collecting stores, was of very considerable size.

The mammals collected number 427 specimens, including 67 monkeys,

110 bats, 71 carnivores, 23 ungulates and 147 rodents. The collection contains many rare and interesting species, such as a series of three specimens of the Pigmy Scaly-tail (*Idiurus panga*), small flying-squirrels of the Ituri District, new to the Museum collection. This Pigmy Scaly-tail was first discovered by the American Museum Congo Expedition of 1914 and differs from the western species (*Idiurus zenkeri*) in its much smaller size and weaker dentition. The flying-membrane, which in this genus and the larger Scaly-tails of the genus *Anomalurus* arises from a cartilaginous spur attached to the elbow joint (in the European and Asiatic flying-squirrels, such as *Sciuropterus*, *Petaurista* and *Pteromys*, the flying-membrane arises directly from the wrist) is, in spite of the small size of the animal, quite well-developed. The so-called "climbing-irons," on the base of the underside of the tail, are in *Idiurus* reduced to a few, roughened, transverse ridges, whereas in *Anomalurus* the "climbing-irons" are composed of a number of hard, horny, backwardly pointing scales by means of which these gliding animals doubtless can obtain a secure hold after a flight. In addition to *Idiurus panga*, which was found by Mr. Hayman in a hollow tree, three species of *Anomalurus* were collected, including a number of the rare Lesser Scaly-tail (*Anomalurus pusillus*), which was hitherto not well represented in the Museum collection. A considerable number of monkeys was secured, the most striking of which is a series of the Red Colobus monkey of the Ituri District known as Elliot's Colobus (*Ptilocolobus ellioti*); this monkey, which was originally described in 1909 from specimens collected by R. Grauer, is now known to be one of the commonest monkeys along the east bank of the Ituri River. On the other side of the river another species of Red Colobus monkey was met with and a considerable series was collected; these monkeys may represent *Ptilocolobus powelli*, or they may turn out to be an unknown species. In addition to these Red Colobus monkeys, two species of the Black and White type of Colobus monkey were collected, and the collection also contains some fine specimens of Dent's Guenon (*Cercopithecus denti*), a monkey which was hitherto considered to be quite a rarity. Among the smaller carnivora is a series of Genets, including a very beautifully marked species, *Genetta victoriæ*, and a number of African Palm-civets (*Nandinia binotata*). A large series of Mongoose forms an important part of the collection, a variety of different genera and species being represented; one of these animals would appear to represent an undescribed species. Among the rodents, two or three of which also seem to require description, several rare genera are represented, the collection containing specimens of *Colomys*, *Malacomys*, *Deomys*, *Otomys*, and *Cricetomys*. Among the Insectivora two specimens of the rare Otter-shrew (*Potomagale velox*) were obtained, and the series of bats includes some rare and little known forms. The most striking of the large mammals are a couple of the Ituri race of the Giant Forest Hog representing the genus *Hylochoerus*; these latter, in addition to being welcome accessions to the collection, were also more than welcome additions to the larder at a time when Mr. Hayman was hard put to it to find meat for the porters.

Among the birds the following may be noticed as being of special interest:—An example of the rare Ibis (*Lampribus akleyorum*), a species which hitherto was represented in Europe by two skins, only one of which is in the Museum collection: a Black Guinea-fowl (*Phasidus niger*), recorded from the Ituri but not represented in the Museum collection from East Africa; a young Reichenow's Pitta (*Pitta reichenowi*) and a Black-shouldered Kite (*Elanus cæruleus cæruleus*), both in an interesting transition stage of plumage new to the collection; and two interesting Spotted Guinea-fowls (*Guttera plumifera* and *Guttera edouardi*), which may represent races new to the Museum collection.

The Reptiles and Amphibians collected number 65 specimens, representing

31 species in all; some are relatively rare and are the first of their kind to be obtained for the Museum collection from the Belgian Congo.

A very considerable collection of Invertebrates was also made; these have not yet been worked through. Over a thousand butterflies were collected by Captain Holloway, and doubtless, when the collection comes to be examined, numerous new forms will be found.

A small collection of botanical specimens and coloured drawings of some of the flowers was made by Captain Holloway; these have not yet been examined.

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Department of Zoology.

Skin and skull of a fine East African Bongo (*Boocercus eurycerus isaaci*) from the Aberdare Mountains, Kenya Colony; presented by Mr. Gilbert Blaine, the well-known big game hunter, by whom the animal was shot. The East African Bongo is a comparatively rare animal, the Museum collection containing only two or three specimens in addition to the original series, so that Mr. Blaine's generous donation is very welcome.

A collection of monkeys and antelopes from the Cameroons; purchased. The collection contains a male mandrill skin and skeleton (*Mandrillus maimon*), and a skin and skeleton of a black colobus monkey (*Colobus satanas*); in addition there are three guenon monkeys and three duiker antelopes. The collection is of value as it comes from Kribi in the French Cameroons, a locality hitherto unrepresented in the collection.

An unusually interesting collection of corals, comprising about 300 specimens; presented by Dr. Cyril Crossland, by whom they were collected in the course of his investigations on the coral reefs of Tahiti. This collection is of the greatest possible value to the museum systematist.

A collection of over a thousand skulls and skeletal preparations of Indian snakes, presented by Col. F. Wall, C.M.G. This is by far the most complete collection of its kind ever assembled. Many of the specimens have been described in Col. Wall's published works on Indian snakes, and the whole collection, prepared by this distinguished herpetologist during his researches, will be of the utmost value to future workers in the same field.

Three mounted mammals presented by the Rowland Ward Trustees:—a Humboldt's Woolly Monkey (*Lagothrix humboldti*), a Flying-squirrel (*Petaurista elegans*) from Java, and a Chinese Palm-civet (*Paguma larvata*).

Department of Entomology.

A valuable collection of South American moths of the family Noctuidæ, comprising 13,102 specimens, of which 174 are the type specimens of their species; presented by Mr. J. J. Joicey, of the Hill Museum, Witley, Surrey.

A selection of Lepidoptera, both butterflies and moths, from the collection of the donor's father, the late Andrew Swanzy, formerly a West African merchant, by whose friends and agents the specimens were collected; presented by Mrs. V. D. Hughes, of Winchester. This series is of particular concern and considerable value to the Department, since it includes practically all the type specimens in the Swanzy collection described by the late Dr. A. G. Butler, a former Assistant Keeper, and admirably figured by him in one of his earliest works ("Lepidoptera Exotica," 1869-74).

The Theobald collection of Aphididæ, consisting of 9258 microscope slides carrying preparations of specimens, among which are 402 types, 19 co-types, and 311 paratypes; bequeathed by the late Mr. F. V. Theobald. With few exceptions all the specimens are named, and the collection includes the material

upon which its late owner based his monograph "The Plant Lice or Aphididæ of Great Britain," published in three volumes between 1926 and 1929, and also his various reports on African and Indian Aphididæ. Besides conferring other advantages of scientific value, the addition of this bequest makes the British Museum collection of this economically very important family the finest in the world, and will be of material assistance in the determination of species.

A male and female of the extinct British race of the Large Copper butterfly (*Chrysophanus dispar*) presented by Mr. C. Sale; the Large Copper ceased to inhabit the British Isles about the middle of last century, and the specimens are welcome additions to the series of this striking insect already in the possession of the Museum.

Department of Geology

A set of four specimens of an extinct aquatic reptile, *Mixosaurus*, from the Alpine Trias of the Lake Lugano district of Italy; purchased. This genus is new to the collection, and is important in being a somewhat aberrant form of Ichthyosaur in which the characters of several bones are reminiscent rather of land than of water animals; indeed, it was on the examination of *Mixosaurus* in 1887 that the late Professor Baur formed his conclusion that the Ichthyosaurs were descended from land animals. *Mixosaurus* was about three feet long and in shape rather like a porpoise. It had paddles for swimming and an elongated tail fin. The specimens purchased include a fine skull and lower jaw, the sclerotic ring of one of the rather large eyes, and a good portion of the vertebral column. Two fine skulls of the Cave Bear (*Ursus spelaeus*) from the caves of the Venetian Carso; presented by Professor G. dal Piaz, of the Royal University of Padua.

A skeleton of the short-legged rhinoceros, *Teleoceras fossiger*, from the Pliocene of Kansas, U.S.A.; purchased. The bones were found in a fluviatile sandstone. The heavy, dense, short bones of the legs are at the bottom of the deposit; the skulls and lighter bones are at a higher level: hence it has been deduced that they are buried in what was once a quicksand. In its general proportions this animal had the build of a hippopotamus.

Two large mammoth tusks from Siberia; purchased.

Department of Mineralogy.

An important addition to the collection of meteorites is a fine mass of meteoric iron weighing 299 lb. and forming a complete individual mass, from South-West Africa. This has been generously presented by the Administration of South-West Africa through the Mines Department. It was one of some thirty masses weighing about ten tons displayed in the Public Garden at Windhoek. These had been collected from the desert in the neighbourhood of Gibeon in Great Namaqualand, where in prehistoric times there must have been a terrific shower of enormous masses of iron.

Another valuable donation is a magnificent group of large crystals of melanterite (iron vitriol) found in ancient workings in the Skouriotissa mine, Cyprus. The individual crystals, 6 to 8 inches across, are of an unusual platy form and are perfectly clear and transparent; further, they are of a fine blue colour, owing to the presence of a small amount of copper sulphate. This specimen has been presented by Mr. J. L. Bruce, the Resident Manager of the Cyprus Mines Corporation, at the suggestion of Prof. C. Gilbert Cullis, of the Royal School of Mines, who brought the specimen home.

Alluvial gold from Ecuador with associated fragments of worked gold, probably fish-hooks lost by the Incas; presented by Mr. H. L. Holloway.

Three lots of minerals from Northern Rhodesia; presented by Rt. Hon. Sir Auckland Geddes, G.C.M.G., K.C.B. (Chairman of the Rio Tinto Co.), Mr. P. Tarbutt, and Base Metals of Northern Rhodesia, Ltd., respectively.

Rocks from Kenya Colony; presented by Prof. J. W. Gregory, D.Sc., F.R.S.

Two large crystals of wolframite from Zinnwald, Bohemia; purchased.

A large series of crystallized lead and zinc minerals from Tsumeb, South-West Africa; purchased.

Agates from Brazil; purchased.

A large, handsome crystal of black tourmaline weighing $10\frac{1}{2}$ lb. from Madagascar, and a further instalment of recently collected Swiss minerals, comprising 411 specimens representing the occurrences at 30 localities, presented by Mr. F. N. Ashcroft.

A fragment of one of the meteoric stones which fell on 29th September, 1928, at Naoki, Hyderabad, India; presented by the Geological Survey of India. A slice of the meteoric stone found in 1912 in Adelie Land, Antarctica; and a portion of a meteoric stone found at Elsinora, New South Wales; received by exchange. Other purchases include the new minerals vauxite, paravauxite, and metavauxite from Bolivia; a large crystal of chessylite from South-West Africa; and rocks from Germany.

Department of Botany.

A collection of 1400 very carefully prepared and named South African flowering plants; presented by Paymaster-Commander T. M. Salter, R.N.

167 crayon drawings of *Russula*; presented by Mr. R. Crawshay. *Russula* is a genus of Agaricaceæ (toadstools) which is characterized by the bright colours of its cap and the clearly cut, paper-like gills. Though easy to distinguish as a genus, many of the species are very difficult to differentiate. During recent years much attention has been paid to the markings on the spore membrane as seen with high magnification. Mr. Crawshay has just published a book, "Spore Ornamentation of the *Russulas*," in which a classification of the species on the basis of the spore characters has been fully worked out. In this work it was impossible to publish drawings of the fungi which were examined, and consequently the original drawings have an additional value.

A collection of 1081 Central European lichens, made by the late Dr. Koerber; purchased.

BOOK NOTICES.

Animal Life on the Seashore. By Professor L. RENOUF. Pp. ii + 78, with 7 plates. (London: George Routledge & Sons, Ltd., 6d.)

THIS little book is No. 19 of the Routledge Introductions to Modern Knowledge. In it the author has attempted to describe in simple language and to figure the commoner natural objects which may be noticed on the seashore. It is difficult to cover adequately so much in so small a compass, and it is no advantage to the illustrations that the publishers have used an inferior type of paper, although it must be admitted that for so low a price too high a quality cannot reasonably be expected. The author has wisely included at the end a useful glossary of the technical terms used in the text, which are there indicated by asterisks. There are altogether eight chapters, entitled respectively: Winkles; Sea Anemones; Mussels; Starfish; Prawns, Shrimps and Crabs; Barnacles; Rag Worms; The Sea Shore.

Animal Ecology and Evolution. By CHARLES ELTON. Pp. 96. (Oxford and London: Clarendon Press. 4s. 6d.)

IN this little book Mr. Elton has embodied the substance of a course of three lectures which he delivered at University College, London, last year. The main thesis developed in it is that "the study of the relations between wild animals and their surroundings cannot be properly conducted without a background of theory or hypothesis on the subject of evolution." He has no difficulty in showing that the mere amassing of raw facts, on which some ecologists pride themselves, is an unprofitable pursuit, and that even a wrong hypothesis may prove better than none at all. His experience of ecological study in this country, in Spitsbergen, and in Canada enables him to illustrate his argument by many telling examples drawn mainly from these regions. Special attention is given to the regulation of numbers and to migration as a special case of what the author calls "selection of the environment by the animal as opposed to the natural selection of the animal by the environment." Throughout the book emphasis is laid on the need for ecological study as a basis for the practical applications of biology and, on the other hand, on its relation to philosophical biology. Mr. Elton writes in an attractive and clear style and the book may be heartily commended to all zoologists. It is refreshing to an old-fashioned zoologist to find one of the younger generation who believes that "you cannot really understand the significance of a thing without having some conception of its past history."

STAFF NEWS.

To fill the vacancy arising from the death of Dr. J. Waterston the Principal Trustees have appointed Dr. Hugh Scott, Sc.D., to an Assistant Keepership (First Class) in the Department of Entomology. Dr. Scott was educated at Trinity College, Cambridge, where he obtained an exhibition, and graduated with first-class honours in the Natural Sciences Tripos, Part 1, in 1906; he proceeded to the degree of doctor of science in 1919. From 1909 to 1928 he was Curator in Entomology in the University Museum at Cambridge. During 1917 and 1918 he was Entomologist to the Hygiene Department, Royal Army Medical College. In 1928 he was appointed Entomologist to the Government of Iraq, but was invalided home the same year. Dr. Scott has had considerable field experience not only at home but also abroad, in the Seychelles, Central Abyssinia, Basutoland, the West Indies, and southern Europe.

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